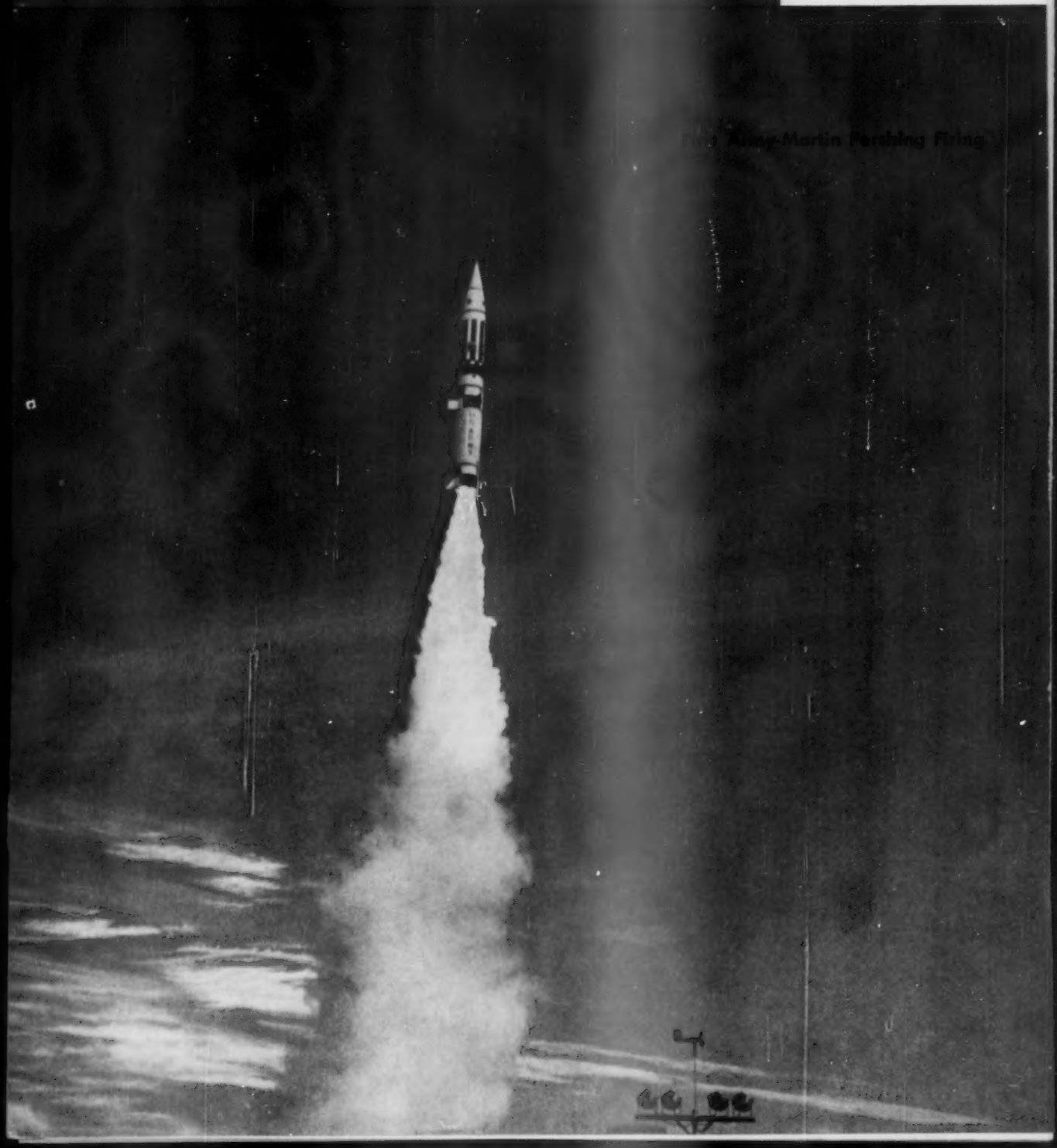
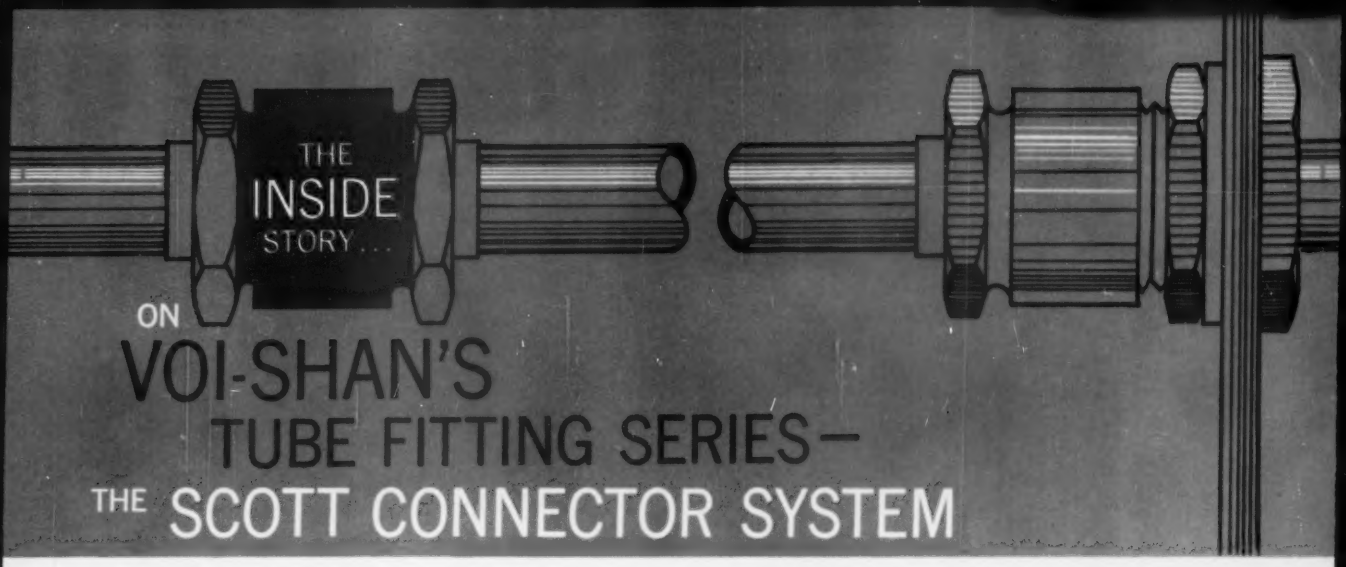
March 14, 1960

Aviation Week and Space Technology

Tiros to Scan Cloud Cover, Earth Heat





ON VOI-SHAN'S TUBE FITTING SERIES— THE SCOTT CONNECTOR SYSTEM

Voi-Shan's introduction of the Scott Connector System made available for the first time a highly versatile standard tube-connecting envelope, adaptable to all types of tubing connections together with the added ability to perform multiple functions. Standardization of this type and on this scale had never been attempted before.

FLARED

The Scott Connector System provides fluid systems designers with such significant assets as:

1. Simple weight savings of up to 75%
2. Greatly reduced mass
3. Flared, flareless or beaded-tubing installations using the same exterior envelope
4. Incorporation of check valves, reducers and other devices as part of the connector's function without changing the envelope
5. Ready adaptability to titanium and other super alloys
6. Very high systems end-cost savings
7. Reduction of human-error factor in installation

Refinement of the "plumbing" art in aircraft construction had lagged considerably behind other structural advances until the advent of the Scott Connector System. The old flared and flareless "heavies" were fine twenty years ago, but today their inefficiency in weight, bulk and restricted function are outdated. Who has not pondered the problems of routing motor-fluid, fuel and air systems through a present-day structure, fighting for every bit of space, while watching the weight factor? Answers to such all too common problems were the basis of the Scott Connector System. The inventor, William James Scott, is today a valued member of Voi-Shan's engineering staff. Earlier, however, for a long time he worked with these problems at the boards and arrived at a design solution. Two solid years of engineering effort at Voi-Shan have proved his ideas right.

FLARELESS

The simplicity of the Scott Connector System disguises the strength and versatility that are only apparent on closer examination. For example, the system is rated for working pressures of 3,000 psi in both flared and flareless versions, using *2024T6 aluminum*, with proof pressures of 6,000 psi and 12,000 psi burst pressure, consistent with the performance requirements of Mil-F-18280. The arduous impulse-vibration requirements of this specification are comfortably exceeded by the flareless version. In addition, transition from flared to flareless-type connection or vice-versa is simply made by changing the connector insert; the outer envelope, consisting of nut and coupling, remains the same: Similarly, for beaded-tube connections—one simply changes the insert. To install a check-valve, a restrictor or a reducer is quite easy—the insert performs a double duty!

Concern about cross-threading or insert misalignment during installation is eliminated by the Scott Connector System. A pilot device on the envelope nut prevents cross-threading and a special land on any insert assures perfect alignment. Correct direction of flow in installing or replacing a check-valve is guaranteed—if it is put in incorrectly the connection cannot be made.

V.HI-PRESSURE

Weight-savings is usually the result of clever design and the Scott Connector System is no exception. The statement above, that a *simple* weight-saving of up to 75% can be realized, means that up to a 75% weight-saving occurs as a *direct* result of the Scott design.

Mass is often a problem in aircraft structure. It aggravates and multiplies fatigue stresses due to local oscillatory effects, and since mass is usually associated with volume, the further problem of location is presented. In modern aircraft this usually means *inside* something, especially since the aerodynamicists object to the hanging of components on the *outside* of the airplane, although unfortunately that is often the only place where space is available. The Scott Connector is very compact; it will satisfy the areodynamicist as well as electrical and control systems engineers.

CHECK VALVE

With military purse strings (and company ones, too) tighter than ever, "cost" is always a consideration. The Scott Connector is not cheap; however, it is inexpensive. The Scott System saves money through simplified inventory, easier installation, and versatility plus a relatively low prime cost.

Voi-Shan's Scott Connector System is available in aluminum, stainless steel and titanium alloy in flared, flareless and flexible versions. If super-high-performance is required (for 4,000 psi systems), an extra-high-strength insert alone will accommodate the requirement. The connectors are available in standard and bulkhead configurations and all standard line sizes are available.

Discover more of the tremendous advantages of the versatile Scott Connector System. Write on your letterhead or use the coupon below indicating any special area of interest with which you may be concerned.

REDUCER

Please send your technical brochure on Voi-Shan's Tube Fitting Series—The Scott Connector System.

Name and Title _____

Company _____

Address _____

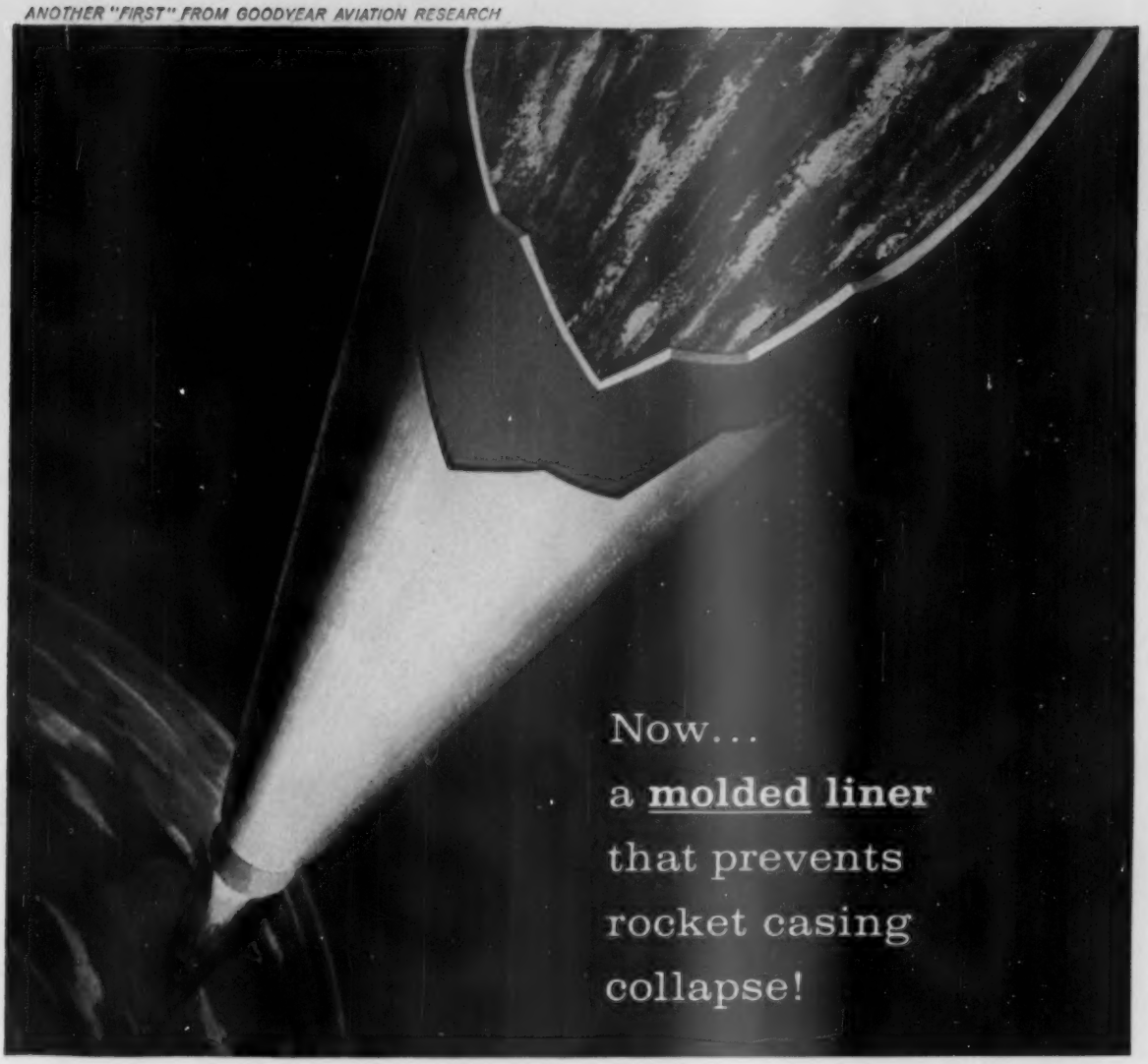
VSI

VOI-SHAN MANUFACTURING COMPANY

A Division of Voi-Shan Industries, Inc.

8463 HIGUERA STREET, CULVER CITY, CALIFORNIA

ANOTHER "FIRST" FROM GOODYEAR AVIATION RESEARCH



1. Keeping rocket casings from buckling under extreme thrust temperatures produced by our second-generation missiles was a serious problem. One solution: Increase casing thickness. But this imposes severe weight penalties. What was needed: A lightweight insulating material able to withstand heat up to 7,000°F. for as long as two minutes.

2. To meet this need, Goodyear has perfected a technique of *high-pressure molding* rocket liners from a new Navy-developed rubberlike compound. Goodyear's molding process on such rubberlike materials achieves unprecedented dimensional accuracy as well as the ability to duplicate this precise accuracy in succeeding production units. Result: A liner that is not only precisely true to specified tolerances but also free of voids and contamination. In use, the liner erodes away and is discharged in the tail blast, leaving no dead weight within the rocket.

3. Now being checked out for advanced missiles, this Goodyear liner makes possible thinner casings—bigger pay loads. Because it's molded, moreover, it can be formed to almost any configuration and degree of taper. Molding techniques for materials, as well as the development of new materials for use in difficult insulation areas such as in tail cones and nose cones for re-entry vehicles, etc., are now being evaluated at Goodyear.

For complete details, write on company letterhead or phone: The Goodyear Tire & Rubber Company, Aviation Products Division, Dept. O-1715, Akron 16, Ohio, or Los Angeles 54, California.

AVIATION PRODUCTS BY **GOODYEAR**

More aircraft land on Goodyear Tires, Wheels and Brakes than on any other kind

59-33

Around the world in 80 minutes

Phileas Fogg needed eighty days to see what the Explorer scans in minutes. Ex-Cell-O Corporation was not then in business to help speed his trip—it was 1923 that Ex-Cell-O started making aircraft parts to tolerances until then deemed impossible in production.

Forty years of Ex-Cell-O experience in high-precision design and manufacturing have helped hurl the Explorer into the sky—have helped guarantee that Ex-Cell-O rocket and missile components embody the delicate strength essential in space.

Twenty-four Ex-Cell-O facilities in the United States specialize in accuracy by the ounce or by the ton... for the future.

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MAN AND MISSILES FLY HIGHER, FASTER AND SAFER WITH PARTS AND ASSEMBLIES BY EX-CELL-O AND ITS SUBSIDIARIES: BRYANT CHUCKING GRINDER CO., CADILLAC GAGE CO., MICHIGAN TOOL CO.

AVIATION CALENDAR

Mar. 21-24—Institute of Radio Engineers' International Convention, Waldorf Astoria and Coliseum, New York, N. Y.

Mar. 23-25—Symposium on Optical Spectrometric Measurement of High Temperatures, University of Chicago, Chicago, Ill. Sponsors: University of Chicago's Applied Science Laboratories; Jarrell-Ash Co.; National Science Foundation.

Mar. 23-25—Ground Support Equipment Conference, American Rocket Society, Statler-Hilton Hotel, Detroit, Mich.

Mar. 24-25—First Annual Symposium on Human Factors in Electronics, New York, N. Y. Sponsor: Institute of Radio Engineers' Professional Group on Human Factors in Electronics.

Apr. 5-8—1960 National Aeronautic Meeting and Missiles and Aircraft Engineering Display, Society of Automotive Engineers, Commodore Hotel, New York.

Apr. 6-8—Structural Design of Space Vehicles Conference, Biltmore Hotel, Santa Barbara, Calif. Sponsor: American Rocket Society's Structures and Materials Committee.

Apr. 6-8—1960 National Meeting "Hyper-Environments—Space Frontier," Institute of Environmental Sciences, Biltmore Hotel, Los Angeles, Calif.

Apr. 11-13—Electrical Engineering in Space Technology, Hotel Baker, Dallas, Tex. Sponsor: American Institute of Electrical Engineers.

Apr. 12-13—14th Annual Spring Technical Conference, Institute of Radio Engineers in conjunction with the American Rocket Society, Hotel Alms, Cincinnati, Ohio.

Apr. 19-21—International Symposium on Active Networks and Feedback Systems, New York, N. Y. Sponsors: Polytechnic Institute of Brooklyn; Department of Defense Research Agencies; Institute of Radio Engineers.

(Continued on page 6)

AVIATION WEEK and Space Technology

March 14, 1960

Vol. 72, No. 11

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The honeybee, Apis mellifera, uses the seven outer segments of its antennas for distinguishing thousands of different smells.

DOUBT vs. CERTAINTY

The honeybee's sensitive antennas are 100 times as efficient as man's unsure sense of smell. This certainty enables bees to locate pollen and nectar. Yet temperatures below 43°F immobilize them and they may starve to death even though food is nearby.

Dorne & Margolin IFF Antennas and RF Components are sure and positive in operation — even under widely varying environmental conditions.

For example, a missileborne antenna must stand the blasting shock of take-off, the intense heat of acceleration to supersonic speeds, and the black chill of outer space . . . and still be sensitive to signals from earth.

Such performance requirements are everyday routine at D & M, where advanced antennas have been developed for aircraft and missiles for the last decade. This wealth of experience often enables D & M engineers to work out a solution to new problems by redesigning an existing antenna developed for a similar purpose. Such shortcuts save time and money . . . while making no compromise with quality and performance standards.

Perhaps the answer to YOUR antenna problem has already been found—at Dorne & Margolin.

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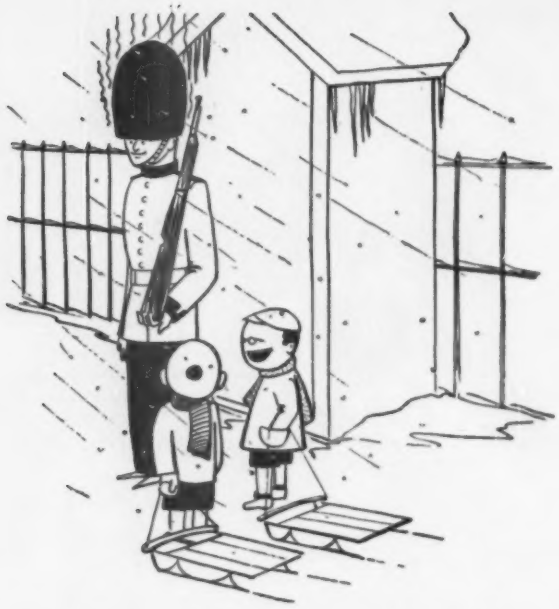
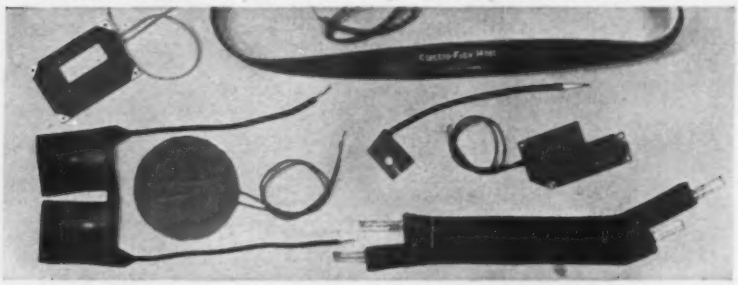


"Blimy, why should 'e get cold? He's got a 'eating h'element in 'is bonnet."

The tougher the heating problem, the better the opportunity for Electro-Flex Heating Elements

For every ridiculous application you can think of there are thousands of practical ones where Electro-Flex heating elements can lick a cold problem. Opportunities are endless. Electronic and mechanical equipment can be made operable, resin cements and plastic laminates can be heat cured, aircraft surfaces can be de-iced, drains defrosted, instruments protected—just to name a few examples.

Electro-Flex has the reputation for solving difficult heating problems better and faster. Engineering is in the hands of experienced heating experts. So, what is your heating problem? Send us the specifications of the application or contact our engineering department for further information.



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"FIRST with STANDARD ELEMENTS"

AVIATION CALENDAR

(Continued from page 5)

Apr. 20-22 – National Symposium on Manned Space Stations, Institute of the Aeronautical Sciences, Ambassador Hotel, Los Angeles, Calif. Cosponsors: NASA; the Rand Corp.

Apr. 21—Annual Eastern Regional Meeting, Institute of Navigation, Key Bridge Marriott Motor Hotel, Washington, D. C.

Apr. 21-22—Southwest Metals & Minerals Conference "Metals and Materials for the Space Age," American Institute of Mining, Metallurgical and Petroleum Engineers, Ambassador Hotel, Los Angeles.

Apr. 21-22—Seventh Annual Heat Transfer Conference, "A Survey of Radiation Phenomena and Heat Transfer Equipment for Space Flight Application," Oklahoma State University, Stillwater, Okla.

Apr. 27-28—National Meeting on Space Age Materials, Cincinnati Chapter of the American Society for Metals, Sheraton Gibson Hotel, Cincinnati, Ohio.

Apr. 28-29—Symposium on "Closed Circuit Respiratory Systems," Wright Air Development Division, Wright Patterson AFB.

May 2-4—National Aeronautical Electronics Conference, Biltmore and Miami-Pick Hotels, Dayton, Ohio. Sponsor: Institute of Radio Engineers.

May 2-5—Sixth National Flight Test Symposium, Instrument Society of America, San Diego, Calif.

May 3-5—Fourth Signal Maintenance Symposium, U. S. Army Signal Equipment Support Agency, Fort Monmouth, N. J.

May 9-11—1960 Symposium of the Institute of Radio Engineers' Professional Group on Microwave Theory and Techniques, Hotel del Coronado, San Diego.

May 9-12—Semi-Annual Meeting and Astronautical Exposition, American Rocket Society, Ambassador Hotel, Los Angeles.

May 9-13—Second Southwestern Metal Congress and Exposition, American Society for Metals, Sheraton Dallas Hotel and State Fair Park, Dallas, Tex.

May 9-13—Annual Conference, Society of Photographic Scientists and Engineers, Miramar Hotel, Los Angeles, Calif.

May 10-12—1960 Electronic Components Conference, Willard Hotel, Washington, D. C. Sponsors: Institute of Radio Engineers' Professional Group on Component Parts; American Institute of Electrical Engineers; Electronic Industries Assn.; Western Electronic Manufacturers Assn.

May 11-14—16th Annual National Forum, American Helicopter Society, Sheraton Park Hotel, Washington, D. C.

May 13-14—1960 National Intercollegiate Flying Meet, Ohio State University Airport, Columbus, Ohio.

May 23-25—12th Annual Meeting, German Society for Rocket Engineering and Space Flight Research, Heidelberg, West Germany.

Aug. 15-20—11th Annual Congress, International Astronautical Federation, Royal Institute of Technology, Stockholm.

Sept. 5-11—1960 Farnborough Flying Display and Exhibition, Society of British Aircraft Construction, Farnborough, Eng.

Sept. 12-16—16th Annual General Meeting, International Air Transport Assn., Copenhagen, Denmark.

GPL combined guidance

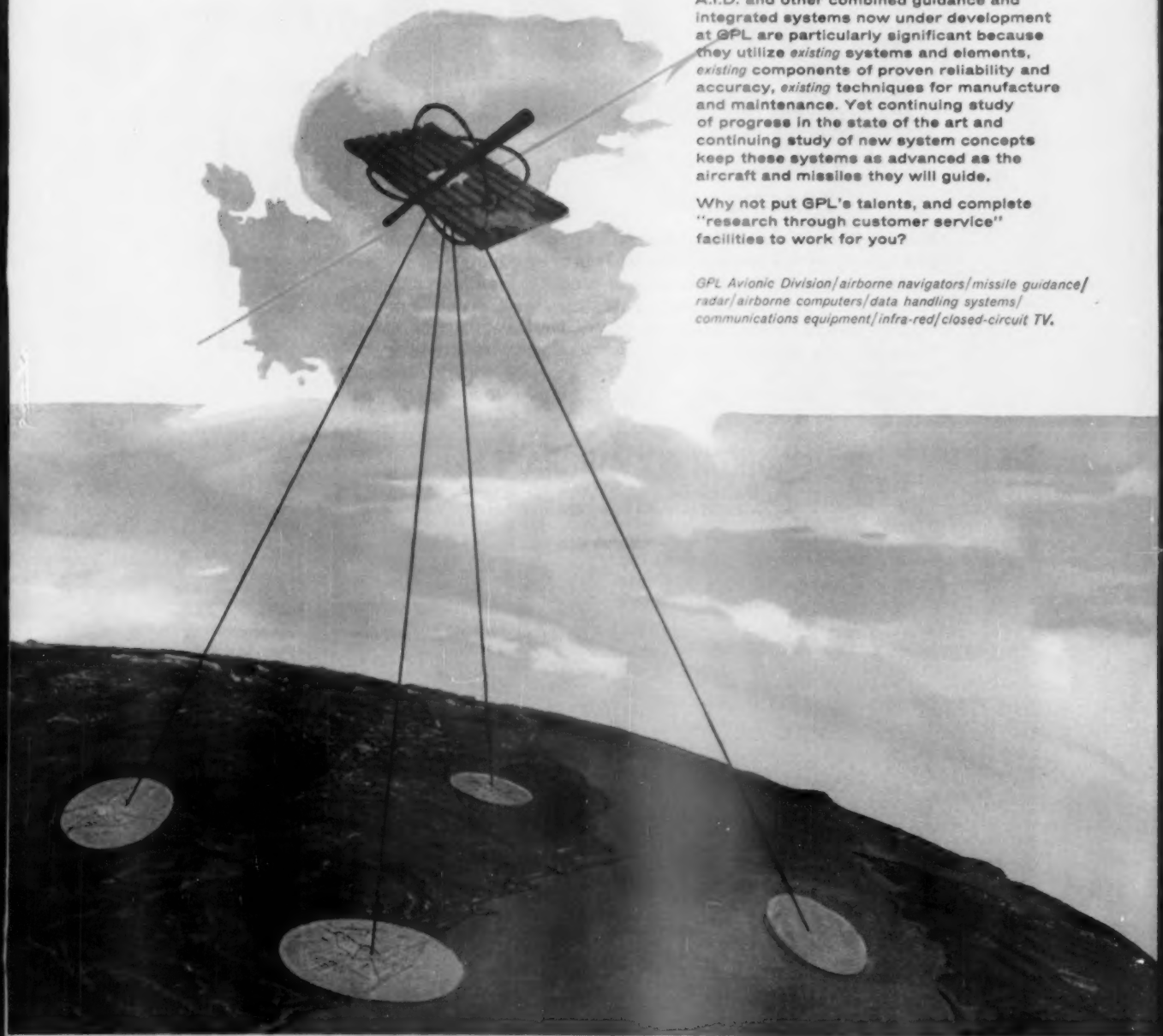
A.I.D. Navigation Systems

Combining state-of-the-art equipment in several fields to create new and superior systems for aircraft and missile guidance is still another GPL capability. One case in point is GPL's Astro-Inertial-Doppler A.I.D. navigation system—a stellar monitored, doppler tuned and damped inertial system—in which each element refines the others, and the system as a whole provides far greater inherent accuracies.

A.I.D. and other combined guidance and integrated systems now under development at GPL are particularly significant because they utilize *existing* systems and elements, *existing* components of proven reliability and accuracy, *existing* techniques for manufacture and maintenance. Yet continuing study of progress in the state of the art and continuing study of new system concepts keep these systems as advanced as the aircraft and missiles they will guide.

Why not put GPL's talents, and complete "research through customer service" facilities to work for you?

GPL Avionic Division/airborne navigators/missile guidance/radar/airborne computers/data handling systems/communications equipment/infra-red/closed-circuit TV.



ENGINEERS—GPL achievements have opened a number of challenging research and development opportunities. To be considered for these career positions, send resume of previous experience to Personnel Director.

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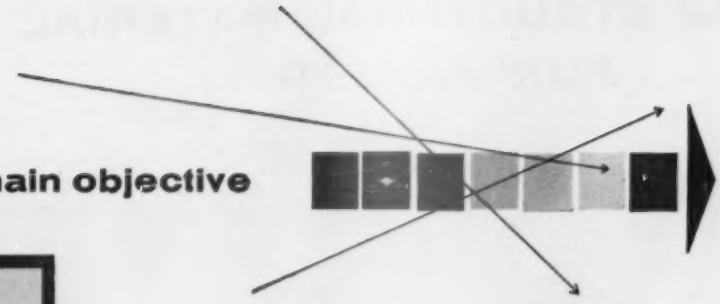
Garlock's main objective



in missiles work . . .

Filament wound rocket motor cases made by exclusive Garlock method result in structure much lighter and stronger than steel.

Insulation for solid fuel rocket motors made by Garlock is rubber-like compound which encounters gas velocities of Mach 3-5, temperatures to 5500° F., prolonged ambient temperatures of 300° F.

Garlock metal fittings for rocket motor cases such as blast tube and thrust terminator support rings are machined to extremely close tolerances. Made from special materials affording minimum weight, maximum strength and rigidity.

is delivery of high quality rocket motor components in the shortest time. To reach this common goal, research and development, product design, tool design, pilot manufacturing, and production staffs work together as a fully integrated team. They solve problems of design and production jointly, thus eliminating weeks of possible re-designing and re-tooling.

Garlock is flexible: they'll swing into prototype production on short notice and follow this with full scale production as needed. *Garlock is diversified:* they'll design and manufacture rocket motor components from a variety of basic materials—rubber, metals, phenolics, fluorocarbon plastics.

Garlock engineers will work to your design or help you in developing designs. Call or write Military Products Department, The Garlock Packing Company, Palmyra, N. Y.

GARLOCK

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Garlock components are presently used in the development and production of:

• Vanguard • Super Vanguard • Polaris • Minuteman • Nike Hercules • Terrier • Super Tartar

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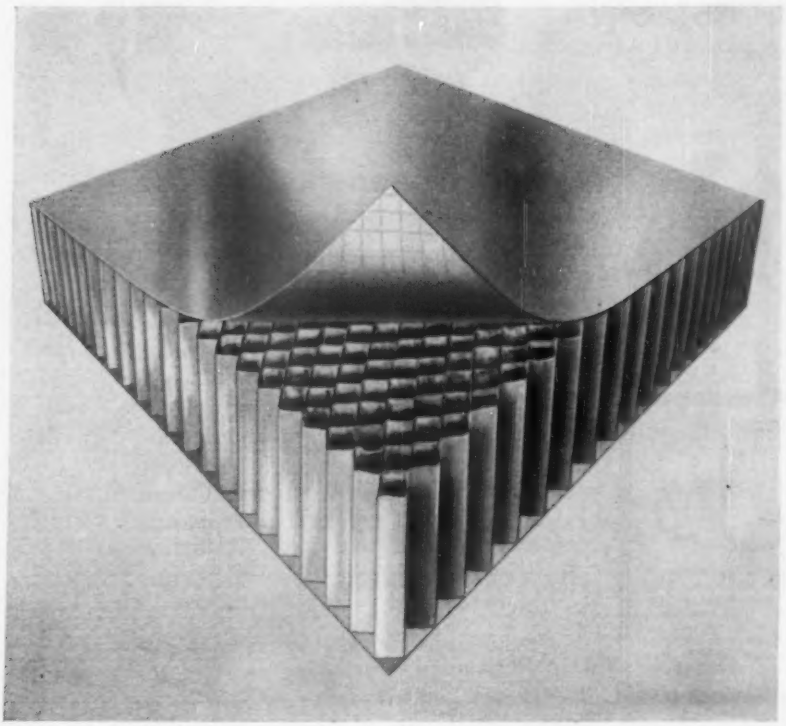

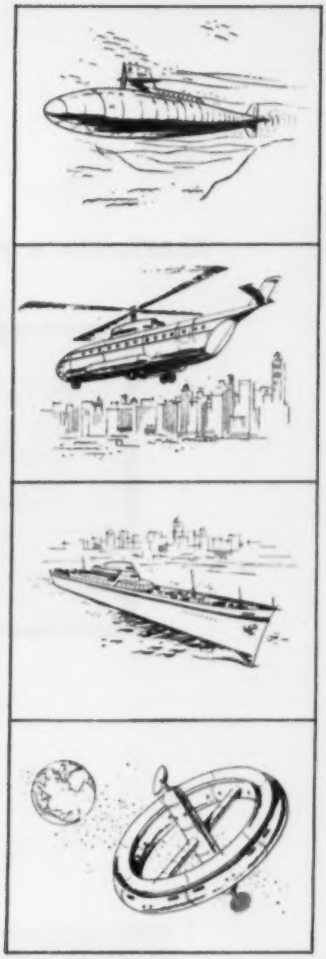

Can you use honeycomb in your business?

New fabrication and manufacturing techniques developed by Rohr show great promise of a cost breakthrough for brazed stainless steel honeycomb sandwich structures. There are countless possible applications throughout industry . . . perhaps in yours.

This incredible material, widely used in the aerospace industry, is earmarked for far broader applications as its unique characteristics become better known to designers.

The "sandwich of steel" is able to withstand great temperatures for prolonged periods — six times that of aluminum, for example. It can cope with sonic and acoustical environments impossible for conventional structures.

Brazed honeycomb sandwich panels offer outstanding insulation qualities, and their structural characteristics are extremely attractive when the problem is to increase strength while substantially reducing weight.

Rohr, a pioneer in the development of brazed honeycomb, has evolved new methods which permit the fabrication of these structures in virtually any size, quantity or configuration, including flat, wedge, curved, and compound curved panels.

For less demanding applications, principally where the problem is one of strength/weight ratio, Rohr honeycomb panels can be fabricated more economically from other materials and bonded adhesively rather than by brazing.

Perhaps you can put this dramatic new material to work in your business. A new brochure, explaining the characteristics of honeycomb paneling in detail, is available upon request. Write Mr. B. R. Alsobrook, Manager, Brazed Stainless Steel Products, Rohr Aircraft Corp., P.O. Box 878, Chula Vista, California.

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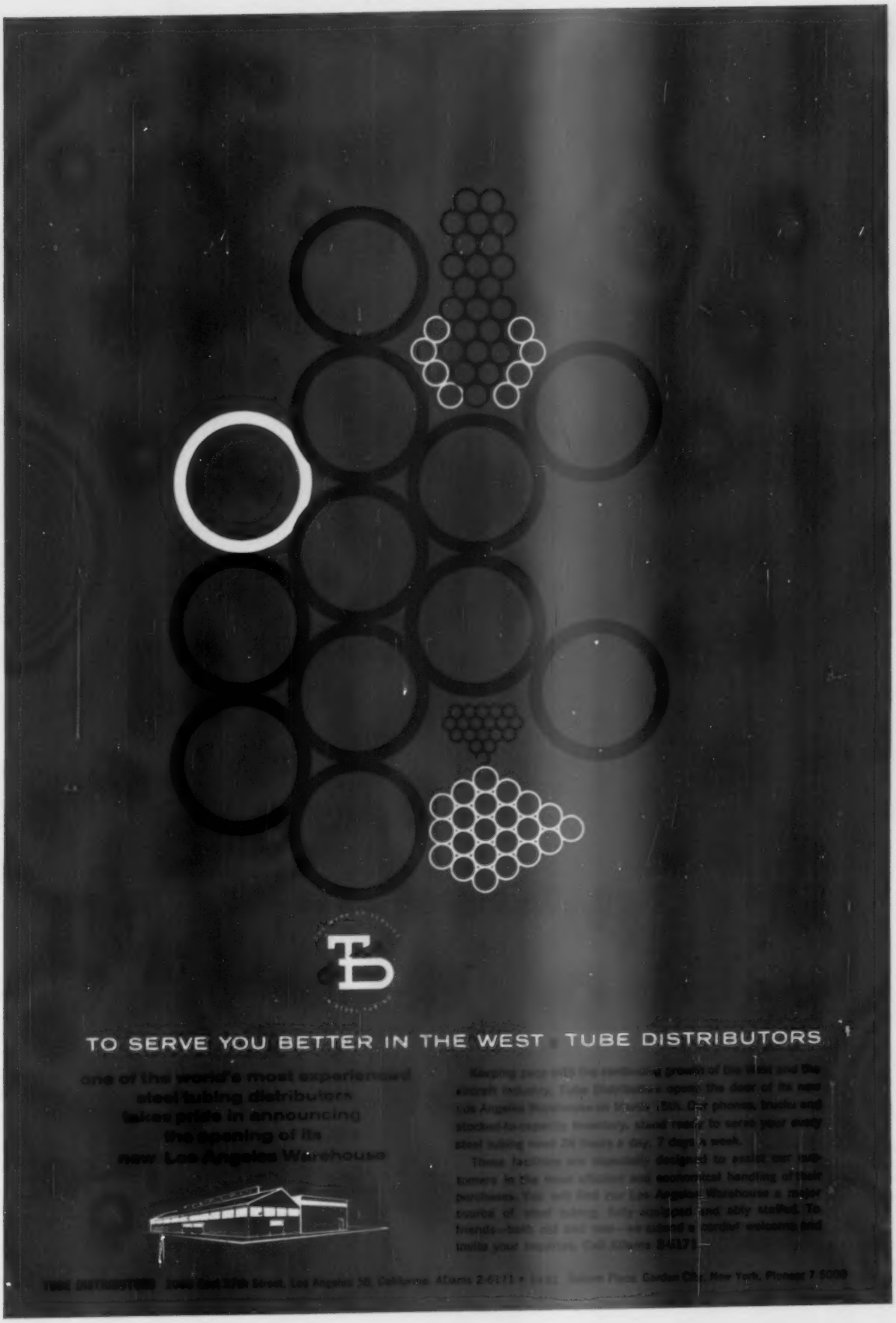
World's largest producer of components for flight • Main plant and headquarters: Chula Vista, Calif. • Plant: Riverside, Calif. • Assembly plants: Winder, Ga., Auburn, Wash.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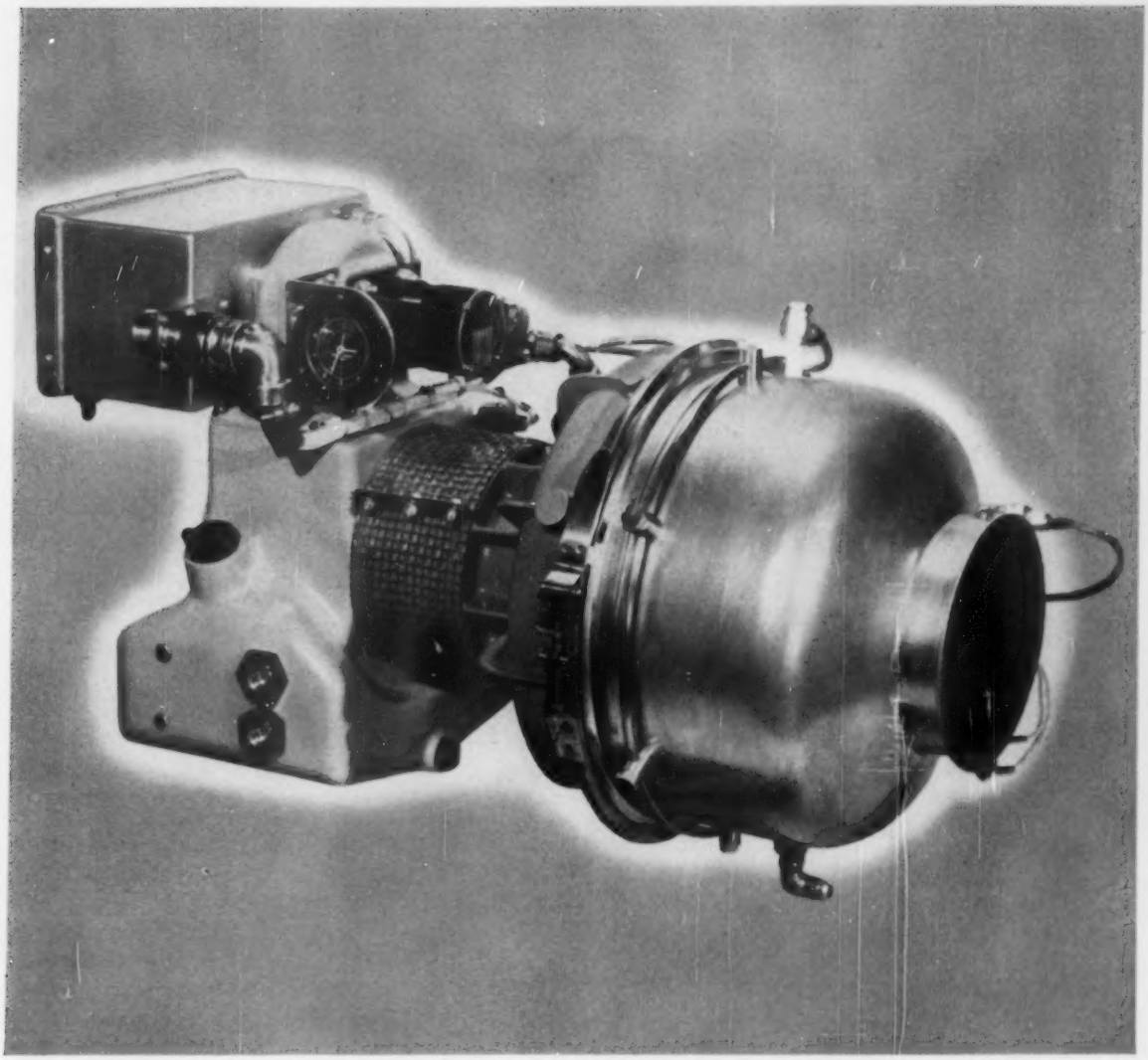


HELICOPTER APU

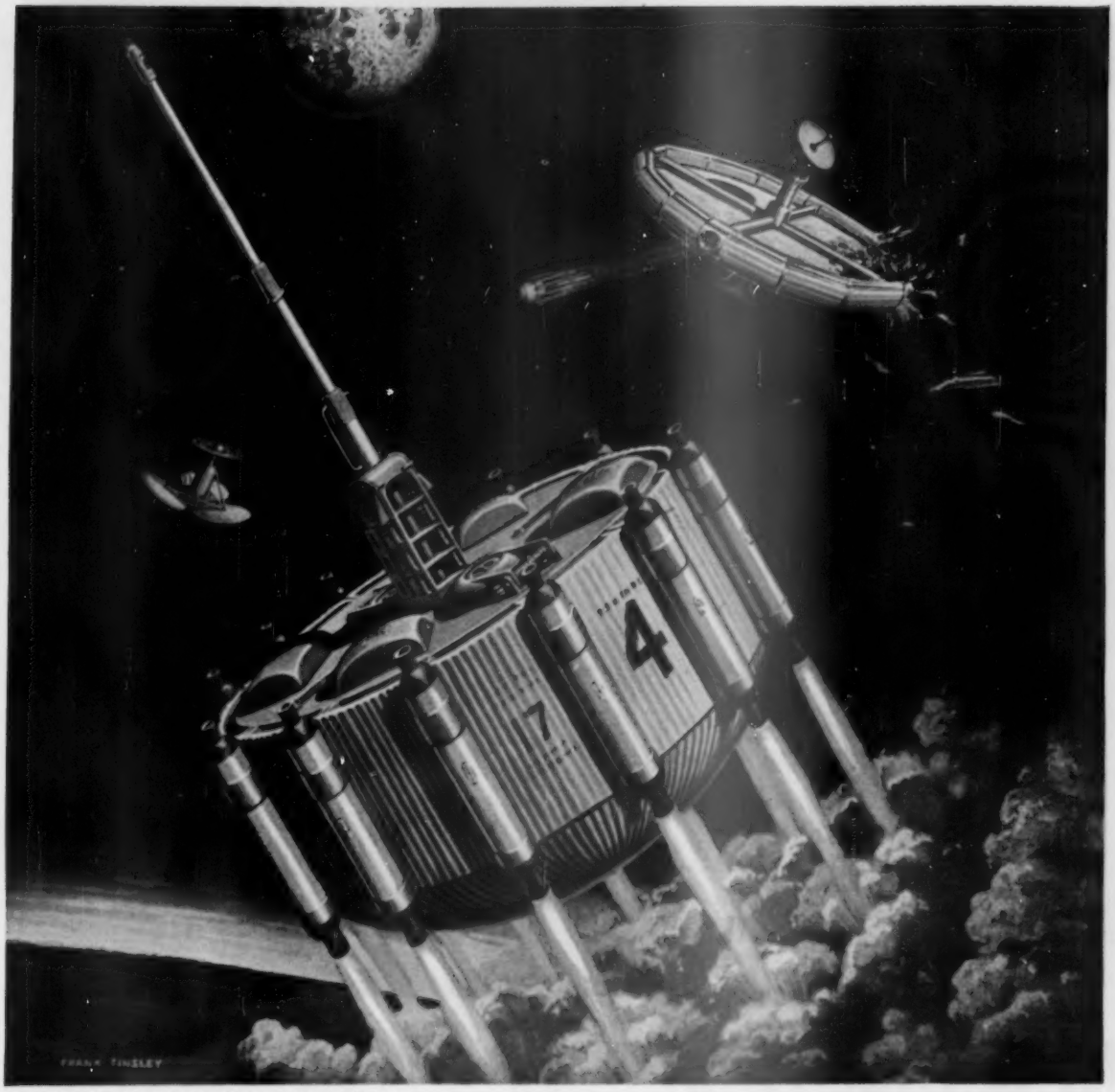
New Solar gas turbine 80 hp APU is only 12½ in. in diameter x 25 in.—weighs 59 lb

SOLAR'S NEW gas turbine-powered helicopter APU occupies only 2 cubic feet—yet provides hydraulic or electrical power for complete checkout, for ground power and to start main propulsion engines. It makes helicopters completely self-sufficient, able to operate from remote locations with no ground support.

Powered by Solar's 80 hp *Titan* gas turbine, the lightweight unit is simple in design, easy to maintain, can be started instantly—without warmup—in temperatures from —65F to 130F and under wide atmospheric extremes. It operates efficiently on a variety of fuels.

Titan gas turbines are setting new standards of performance and reliability as propulsion units for one-man helicopters, in portable electric generators and in other applications. For details, write to Dept. G-189, Solar Aircraft Company, San Diego 12, Calif.

SOLAR
AIRCRAFT COMPANY



STEPS IN THE RACE TO OUTER SPACE

Escape In Space

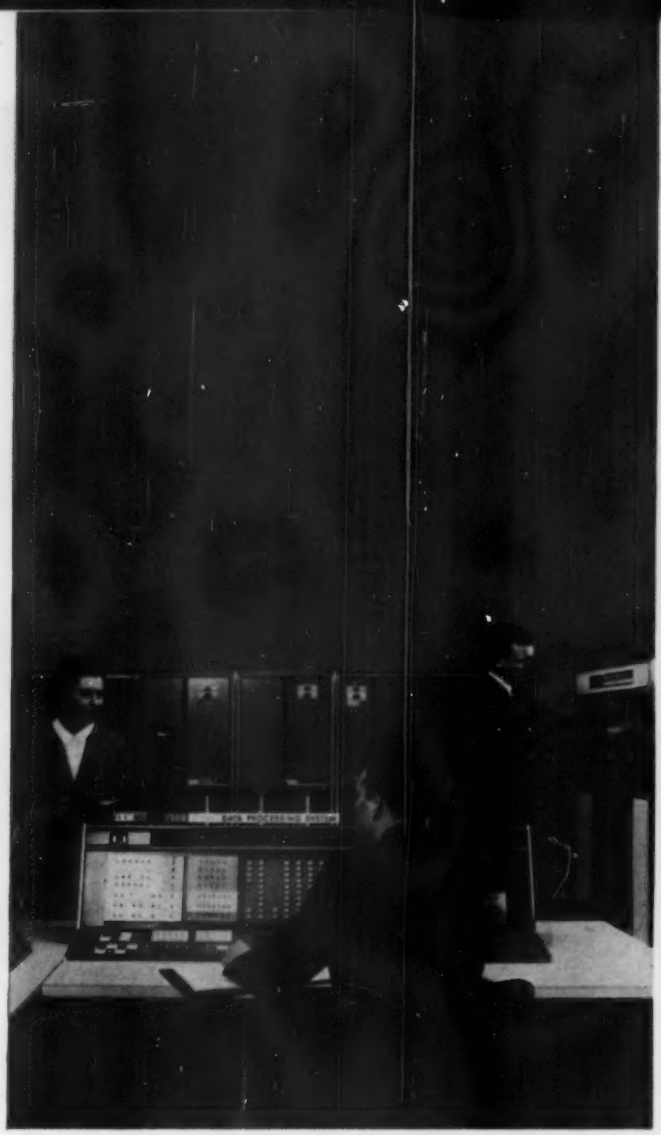
The space-assembled super satellites of the future will periodically encounter disaster—collision, mechanical failure, military attack, or the long chance of being hit by a meteorite. When this happens, "life boats" like the one shown here will bring their crews safely back to earth.

Here is the operational sequence of an escape in space:

1. Crew members don pressure suits and strap themselves into decelleration beds within the pressure-intact unit.
2. At the "Abandon Ship" signal, low-power, RATO-type launching rockets blast the sealed capsule from the threatened station (upper right illustration).
3. Acting on orders from an astrogational computer, the retro-rockets check the capsule's speed and break it out of orbit. (Foreground. Note details of offset heat shielding, hatches, slow-down parachute covers.)
4. As the capsule enters the outer atmosphere, the heat shield protects the astronauts. The life boat's momentum slows even further, and the shield is jettisoned as it cools.
5. Four parachutes are released, acting as air brakes. After a computed interval, other chutes are released.
6. The capsule lands in a predetermined sea rescue area, and a ring of flotation bags inflate. A radio broadcasts the craft's location, and a bright sunshade serves as a visual and radar target for rescuers.

ARMA, now providing the inertial guidance system for the ATLAS ICBM and engaged in advanced research and development, is in the vanguard of the race to outer space. For this effort, ***ARMA*** needs scientists and engineers experienced in astronautics. ***ARMA***, Garden City, New York. A Division of American Bosch Arma Corporation.

AMERICAN BOSCH ARMA CORPORATION



Announcing IBM's newest, most powerful business computer...

NEW IBM 7080 *transistorized data processing system*

NEW
2.18 millionths of a second operating cycle

NEW
1.09 millionths of a second communication cycle

NEW
automatic overlapping of multiple operations

PLUS
compatibility with all IBM 705 Systems

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A business system with new speed and power, the transistorized IBM 7080 processes IBM 705 programs up to **ten times** faster.

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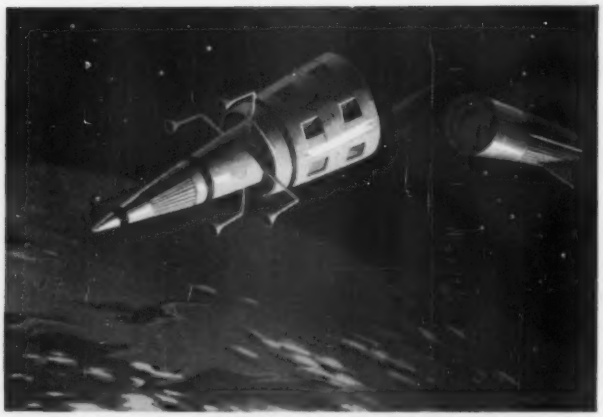

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- RELEASE FROM LAUNCHING PADS.
- RELEASE OF BOOST ROCKETS AND LAUNCHING SLEDS.
- RELEASE OF TANKS AND JETTISONABLE ITEMS.

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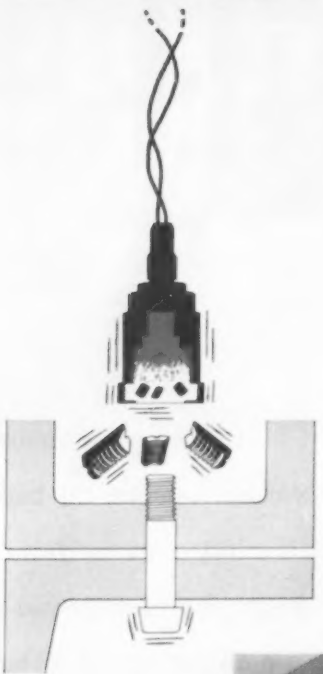

A unique, safer and more efficient method for separation systems is offered by the Separation Nut.

The Separation Nut is unique because its controlled separation is a highly reliable mechanical function activated by a very small explosive charge.

By using the Nut's small explosive charge rather than the "brute force" explosive techniques so commonly used to fail high strength material in explosive bolts, the Separation Nut can substantially reduce a potentially hazardous condition to installation crews and to the vehicle itself.

More compact joints can be designed since Separation Nuts are used in combination with standard diameter, high strength bolts used at full allowables.

Separation Nuts reflect another new fastening concept developed in Hi-Shear's specialized engineering and laboratory test facilities for the specific needs of space vehicles and high performance aircraft.

Write for brochure . . . describes how the Nut works, high speed photos, design goals, typical applications and summary of the test program.

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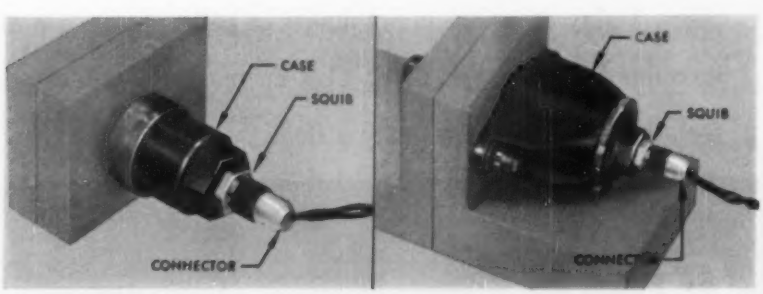

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Basic configuration . . . accommodates bolt thread sizes including ¼-28 thru ¾-16.

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Because only a low explosive charge is used, all fragments can be easily contained by Nut's case. A similar case can arrest a bolt after detonation.

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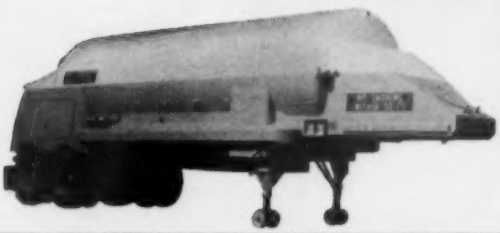

Model 4100 M has been endurance tested over Belgian block and gravel roads, plus rugged cross country hauling. It has been environmentally tested at temperatures ranging from −65° F to 160° F. It has been subjected to salt spray, rain, fungus, sand and dust. Similar units are now in operational use by the military.

Transport problems usually associated with liquid hydrogen have been successfully solved by STANDARD trailers. Since mid-1957 these trailers have been used for deliveries more than 1000 miles distant. The illustrated unit has a capacity of 5400 gallons.

This 1500 gallon liquid oxygen transport has an inner shell of stainless (type 304), with an outer shell of carbon steel. This unit, pictured prior to addition of trim, is manufactured at STANDARD'S Leader Iron Works plant and is principally used for transporting liquid oxygen to industrial plants.

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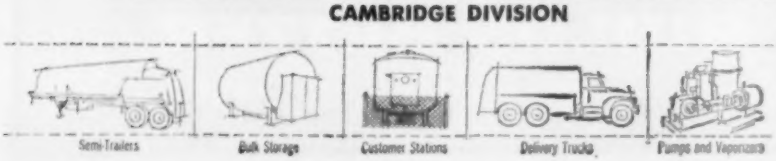

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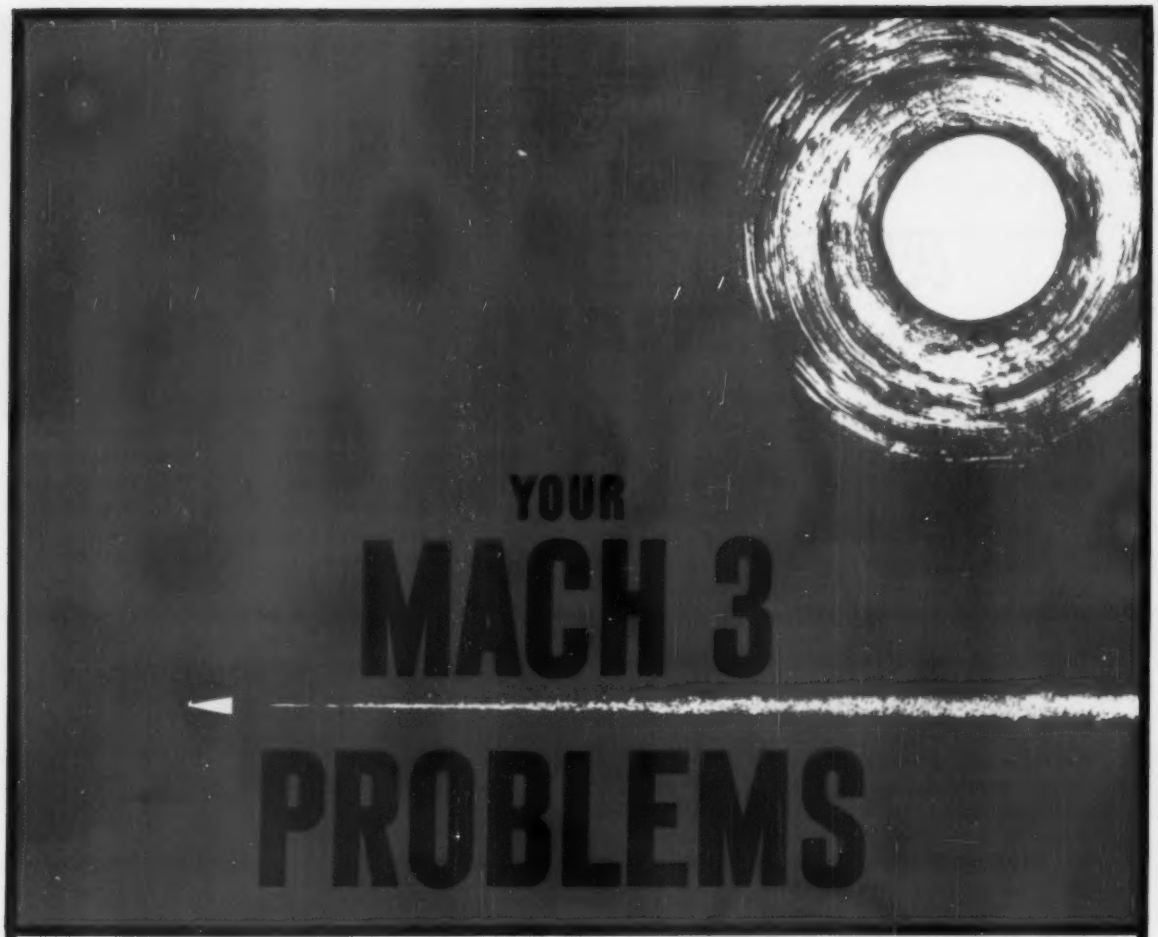

may already be solved at RYAN

At Mach 3—three times the speed of sound—the heat becomes unbearable for conventional airframe metals. The stress becomes too great for conventional methods of fabrication. These are problems which have been overcome by new design concepts and advanced manufacturing techniques at Ryan.

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March 14, 1960

Aviation Week and Space Technology

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COVER: Army-Martin Pershing tactical missile test vehicle launching at Cape Canaveral, Fla., (AW Feb. 29, p. 34) was considered successful. The solid propellant vehicle flew about 20 mi. under power of first of two stages. For other pictures, see p. 87.

PICTURE CREDITS

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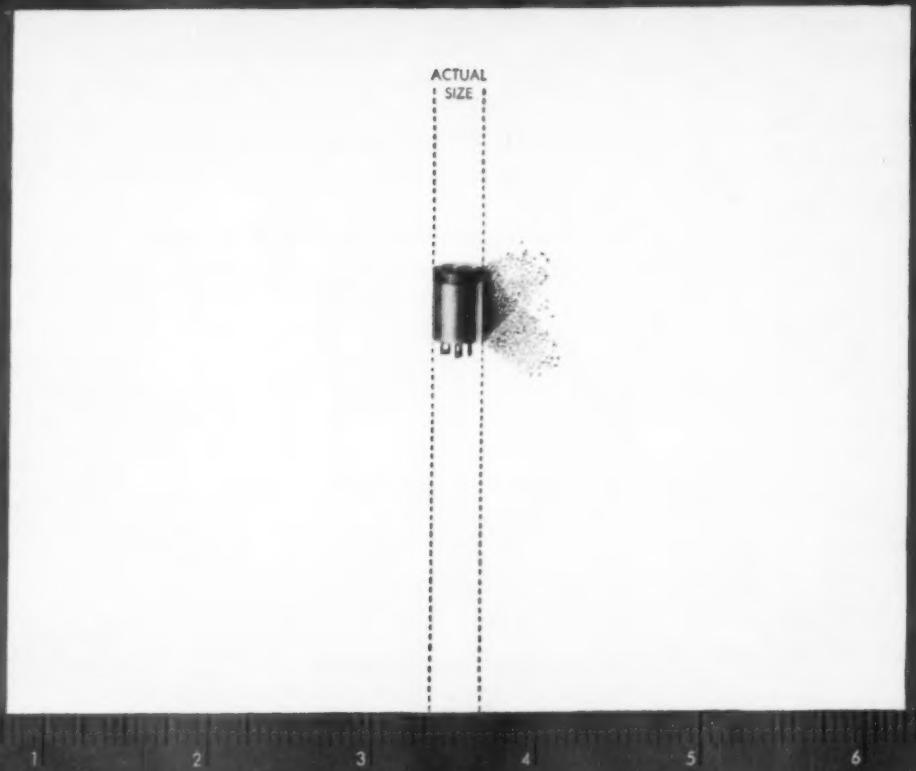

KLIXON TYPE AT1-1

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Here is the answer to a designer's prayer for the smallest, lightest, snap-acting, environmental free switch that can be made and yet still be a reliable, precision device. Write for further detail on various means of mounting and actuators.

SPECIFICATIONS
of KLIXON Type AT1-1

Actuating force	12 ± 8 ozs.
Release force	1 oz. minum.
Pretravel	.005" approx.
Overtravel	.003" min.
Movement differential	.002" approx.
Minimum life cycles	10,000
Weight	.036 ozs.
Amb. temp. range	65°F to 275°F
Current capacity	3 amps. 28VDC resistive
Contact separation	.010" approx.
Vibration resistance	40 G's
Shock resistance	100 G's

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EDITORIAL

Defense Debate Sharpens

Testimony by five Republicans who are not running for elective office gave new impetus to the running debate on the adequacy of the nation's defense preparations and produced indications that the Republican Administration may be forced into major concessions on the Fiscal 1961 defense budget now being considered by Congress.

The past records of the five Republicans made it difficult for any Administration spokesmen to impugn their motives in criticizing the current defense program or to challenge their competence on defense matters.

They were:

• **Robert Lovett,** former Secretary of Defense, now a partner in Brown Brothers, Harriman & Co. and chairman of the executive committee of the Union Pacific Railroad.

• **Robert C. Sprague,** chairman of Sprague Electric Co. and chairman of the Federal Reserve Bank of Boston and director of the Gaither Committee.

• **Thomas Watson, Jr.,** president of International Business Machines Corp.

• **Thomas G. Lanphier, Jr.,** vice president of the Convair Division of General Dynamics Corp.

• **Dr. James P. Baxter, III,** president of Williams College and a member of the Gaither Committee.

The fact that Republican businessmen with considerable practical experience with defense policy have reached pretty much the same conclusions regarding our current defense problems as the Democratic senators who have been spearheading the defense debate in Congress should require every American citizen to take a new, hard look at this debate. For, until this distinguished quintet offered public testimony on this subject, the defense debate could be colored to look as though it were a partisan, election-year maneuver, which it most certainly is not.

Issues Become Clearer

Now, it will be hard for the Administration to maintain this fiction, and the real issues should become clearer to the American taxpayer. It is too bad that the Republican side of the defense debate has been carried only by the florid Fourth of July oratory of Senator Everett Dirksen; the honestly intended but poorly informed efforts of Senator Leverett Saltonstall, and the stubborn insistence of President Eisenhower that he is the nation's foremost defense authority. For as long as the defense debate was kept in a strictly partisan political environment, its contributions to a better defense policy were limited.

The voices of these five Republicans who are seeking no elective office speaking forthrightly according to the dictates of their conscience, and with the benefit of their professional experience in the defense area, should make it clear that this is no partisan matter but something of vital concern to every American.

There are numerous signs that the Administration is deeply worried by the rising tide of public opinion this testimony is stirring. Vice President Nixon has his staff working busily on preparation of a strong defense plank for his 1960 platform which will probably bear little resemblance to the official position of President Eisenhower at the commencement of this fateful year in world history. White House aides also are scurrying through the Pentagon to gather ammunition for some sort of official presidential statement to answer the rising tide of defense criticism and soften some of the blast expected from the initial report of the House Appropriations Military Subcommittee due in late April. All efforts to suppress or divert the defense debate into ineffective channels have failed, and the course now lies clear for action.

Major Points

There is a surprising unanimity about all of the major points raised by critics of the current defense policy. Virtually all of them agree that:

• **We are not doing enough to meet the Soviet threat.**

• **We can do more without straining our economy in any way.**

• **We have reached the point in time where it is necessary to do more if we are to hope for any success in blunting the Soviet challenge.**

In addition, there is almost universal agreement among these critics, regardless of their political affiliation, that our most serious deficiency now lies in vigorous executive leadership, from the top down, to replace the vague vacillating products of our current system of decisions through committees, councils and study groups.

Perhaps the best statement of our national goals was contributed by Thomas Watson when he said:

"Our national goal should be clear superiority over the Soviet Union in all possible areas, and we should believe enough in democracy so that we will not be reluctant to fully enter the contest."

The most serious warning came from Thomas Lanphier, Jr., who just resigned a $64,000 a year vice presidency with Convair to publicly and uninhibitedly debate the defense issues when he said:

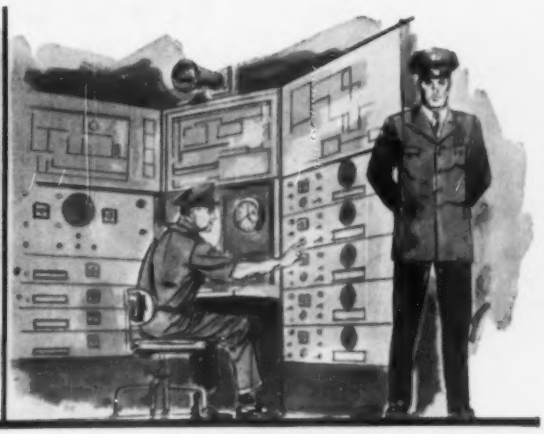
"My country may this winter be in the process of losing World War III. I believe we are losing World War III for among other reasons, the lack of a sufficient and timely ICBM program; lack of a defense against submarine attack; lack of a sufficient and timely space program and above all lack of recognition that we are and have been for a long time actually engaged in World War III."

We should take the warning of Mr. Lanphier and the hope of Mr. Watson equally to heart and from them fashion a policy that will enable this country to secure its future and continue its leadership in the world.

—Robert Hotz

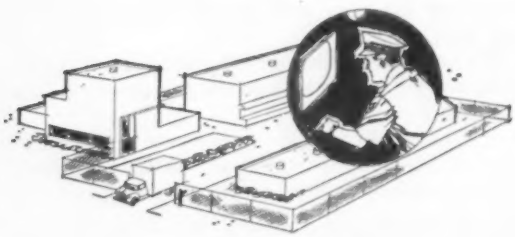
All-new concept in Classified Area Protection

Guard posts mean fixed overhead; guards can't be everywhere at once.



Honeywell's protective system cuts overhead; blankets every square foot every moment!

New Honeywell system makes possible sight, sound and movement surveillance of an entire facility from one central location!



Greater protection for far less money

Here is a completely new concept in protective systems—a system that will not only pay for itself within a year by eliminating costly guard posts, but go right on adding to your profits for years.

For example, for every 24-hour guard post that you eliminate through this Honeywell system, you can save up to $25,000. In larger areas, where more costs are eliminated, savings increase proportionately.

With this new Honeywell system, a central security guard at his console can check instantly the security of any building or area—even remote gates 20 miles or more distant. It protects your property against intrusion by all three means of detection: 1. Physical—the actual breaking in through doors or windows. 2. Audio—detection of sound or noise created by the intruder. 3. Motion—detection of movement of anyone that may have concealed themselves within the plant.

Complete protection requires checks and balances

Teamed with your security force, a Honeywell automatic alarm system can detect any form of illegal entry, loitering, vandalism or sabotage. In many cases, a number of guard posts can be eliminated permanently. However, a security system would hardly be realistic without personnel to execute the program—and the Honeywell system is designed to complement manpower, thus permitting a greater degree of security without increasing your security force.

Key to the Honeywell system is the central control panel. All of the various sensing devices report here and all communications are centered here under one man's constant supervision. Intrusion, no matter how detected, is signaled and its location indicated here. Detection of fire is reported here and various critical alarm functions of the building can be monitored here—including complete surveillance of temperature, refrigeration, lights, boilers, flows.

Honeywell service assures maximum savings

Honeywell service adds to your savings—because it includes far more than ready access to one of our 112 branch offices. It includes field engineering help in planning your system, in addition to a service guarantee and a really dependable maintenance contract.

For a free survey of your facilities, call your nearest Honeywell office, or write: Minneapolis-Honeywell, Department AW-3-13, Minneapolis 8, Minnesota.

SUIT THE SYSTEM TO YOUR NEEDS

CENTRAL PANEL locates intrusion or fire.

VITRONIC EYE detects motion in lighted areas.

SONIC DETECTION hears noise of intrusion.

AUTOMATIC FIRE and smoke detection and location.

SONO-SENTRY sensor system detects motion.

MAGNETIC DOOR SWITCH signals intrusion.

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WHO'S WHERE

In the Front Office

Col. Edward N. Hall (USAF, ret.), assistant to the vice president and chief scientist of United Aircraft Corp., East Hartford, Conn.

North American Aviation, Inc., Los Angeles, Calif., has elected the following corporate vice presidents: **William H. Cann**, vice president and secretary; **William M. Darling**, contracts and pricing; **Rulon Nagely**, material; **John B. Pearson**, development planning; **Eugene D. Starkweather**, personnel; **John W. Young**, quality and logistics.

Dr. Glenn G. Havens, a director, Telecomputing Corp., Los Angeles, Calif. Dr. Havens is a vice president of Telecomputing and board chairman of Narmco Industries, Inc., a subsidiary.

Joseph H. Schellman, president of the newly formed Control Switch Division of Controls Company of America, Schiller Park, Ill. Also: **Harold F. Ames**, a vice president of Controls Company of America and director of sales for the Control Switch Division.

Dr. Albert C. Hall, vice president of engineering, The Martin Co., with headquarters in Denver, Colo. Also: **Dr. William L. Whitson**, director of advanced programs for The Martin Co.'s Denver Division.

Jack G. Anderson, vice president-government relations, Stromberg-Carlson Division of General Dynamics Corp., Rochester, N. Y.

Gerald J. Lynch, vice president of the newly established Defense Products Group of Ford Motor Co., Dearborn, Mich. Mr. Lynch continues as general manager of the Aeronutronic Division and also will direct the operation of Special Military Vehicles, Mobilization Planning and Defense Sales, and Defense Contract Administration.

Dr. John V. Atanasoff, vice president-Atlantic Division of Aerojet-General Corp., Frederick, Md.

John R. O'Brien, vice president-government relations, Military Products Division of Hoffman Electronics Corp., with headquarters in Washington, D. C.

Loren A. Murphy, vice president-manufacturing, Goodyear Aircraft Corp., Akron, Ohio.

William W. Wood, Jr., executive vice president-development and engineering, Link Division of General Precision, Inc., and also a director of General Precision, Inc. Other Link Division appointments: **Edward W. Sheridan**, manager of Eastern Laboratories, and **Hugh M. Williams**, vice president in charge of Western Laboratories.

V. B. Benfer, vice president-development, Pacific Airmotive Corp., Burbank, Calif. **James L. Fechter** succeeds Mr. Benfer as president of PacAero Engineering Corp., a subsidiary of Pacific Airmotive.

C. H. Chichester Smith, managing director, The Fairey Co., Ltd., London, England, succeeding **Geoffrey W. Hall** who continues as chairman. **C. C. Vinson** and **L. S. Dawkins** appointed directors.

Ralph Harmon, vice president-engineering, Mooney Aircraft, Inc., Kerrville, Tex.

(*Continued on page 113*)

INDUSTRY OBSERVER

▶Convair, Douglas and North American Aviation's Missile Division are among the leading contenders for a National Aeronautics and Space Administration contract to build the airframe for the 23,000-lb.-thrust S-4 stage of the Saturn vehicle. Proposals for airframe are being evaluated by NASA.

▶Initial two Midas infrared early-warning satellite test launches have been scheduled for the Atlantic Missile Range because of scheduling problems at Vandenberg AFB, Calif., but the remainder of the Midas tests and all Samos reconnaissance satellite launches will be made from Vandenberg in order to obtain polar orbits unless further scheduling problems arise. First Midas launch from Cape Canaveral was attempted late last month; the second is scheduled before the end of March.

▶East German sources report that Veb Entwicklungsbau Pirna is developing a bypass version of the basic Pirna O14 engine scheduled for the Baade Type 152 jet transport. More-powerful Pirna O14 is reportedly now being flight tested on a four-turboprop Soviet aircraft believed to be the Bear bomber. Test nacelle can change angles of pitch and yaw in flight to obtain data over wide range of inlet angles of attack and to determine transient flow conditions. Turboprop engines of the Bear bomber are operating at increased rating of 15,000 eshp. each, according to East German sources. Earlier rating of the engines was 12,000 eshp. each.

▶Soviet Union has built a 53-lb. engine for use in light aircraft, powered gliders and small single-place helicopters. Designated the VP-760, five-cylinder radial engine is rated at 22 hp. at 2,300 rpm. Working volume is 0.760 liters; compression ratio is 8:1.

▶Rome Air Development Center last week awarded a $78,171 contract for study of spectral suitability, modulation and detection techniques for communications in the optical region between near infrared and ultraviolet to the GPL Division of General Precision, Inc. Optical region is expected to extend the usable portions of the electromagnetic spectrum and to offer highly-directional, jam-free space communications. ARDC's interest in this field and GPL's work in this area were described in the Jan. 4 (p. 15) and Feb. 22 (p. 63) issues of Aviation Week.

▶Universal microwave command guidance, a radar guidance and automatic track system made by the Sperry Phoenix Co., has successfully passed its flight test requirements in a QF-80 drone at Holloman AFB. Telemetry and command accuracy and system reliability were reportedly excellent.

▶With cutback in North American B-70 program to prototype development, Air Force has abandoned a project for development of tires capable of withstanding prolonged heat soaking at 450F and then landing. USAF plans instead to use currently-available 250F tires and take the weight penalty of air conditioned wheel wells.

▶North American Aviation, in a step that could lead to further diversification, has formally presented a design proposal for a high-speed hydrofoil patrol craft to Navy's Bureau of Ships. Speed range of the hydrofoil vehicle would be between 60 and 100 kt.

▶Nike Zeus launch complex has entered the advanced stage of construction at the Naval Missile Center, Pt. Mugu, Calif. The Army anti-missile missile can be expected to begin flight tests from the Pacific Missile Range base by mid-year. Some form of silo launch probably will be used in the tests. Guidance and canard control systems have yet to be flight tested.

▶Polish cyclotron is scheduled to go into operation within near future at the Nuclear Research Institute near Prague. Cyclotron will be capable of accelerating neutrons to an energy of 12.5 million electron volts; alpha particles to an energy of 25 million electron volts.

As North American's X-15 – world's most advanced manned research craft–parts the curtain of earth's atmosphere, the arts of guidance and direction must play a critical role. Sperry's Air Armament Division, assigned the Flight Data System responsibility for the X-15, is meeting the challenge with inertial guidance gear of advanced design, precision and dependability.

But the problems of inertial guidance are not new to Sperry. During the past ten years, over 25-million Sperry man-hours have been employed to develop and produce successful inertial guidance. As a result, the nation has in the Convair B-58 Hustler the most thoroughly studied, analyzed, tested, evaluated and understood inertial guidance system in being – plus the advanced guidance equipment for the X-15 and for other future applications.

And in addition to work on government sponsored space guidance systems and techniques, Sperry scientists and engineers are exploring new and exotic techniques for gyros, advanced miniaturized digital computers, acceleration sensors, zero gravity environment systems–in many cases involving radical departures from current technology–with the aim of developing concepts, systems and hardware that are *ahead* of the challenges of man in space.

SPERRY

AIR ARMAMENT DIVISION, *SPERRY GYROSCOPE COMPANY, DIVISION OF SPERRY RAND CORPORATION, GREAT NECK, NEW YORK*

Washington Roundup

Watch for the debate over the adequacy of the Administration's hold-the-line budget policies to become even more bitter, reaching a climax late next month when the House Defense Appropriations Subcommittee issues its report. Despite charges of "unpatriotic" and "parochial" being hurled at critics of the Administration's Fiscal 1961 budget, the subcommittee probably will increase funds to provide a continuous airborne alert capability, provide more money for airlift, ballistic missiles, including the Polaris weapon system, and for hardening of ICBM bases.

If the criticism becomes too severe, and—possibly more importantly—if leading Republican businessmen continue to join in the chorus in this election year, the Administration may try to avoid a congressional showdown. One way would be to "reappraise" its position, ask for a supplemental request before the Appropriations Committee headed by Rep. George H. Mahon (D.-Tex.) issues its report.

Congress also may foreclose on Defense Department's Advanced Research Projects Agency. House Armed Services Committee already has voted to abolish ARPA, created as an independent operating agency two years ago, by repealing the agency's statutory authorization contained in the Fiscal 1961 military construction bill.

House Committee contends that ARPA is no longer functioning as an independent agency but as an adjunct to the office of Dr. Herbert York, Defense Department director of research and engineering. For this reason, committee says it appeared sound to "repeal the statutory authority which created the agency since it no longer was necessary."

Space Committee Shift

House Committee on Science and Astronautics probably will discontinue its practice of having a military representative assigned to the committee staff as an adviser and consultant. Reason cited by committee members is that the representatives are not assigned to the staff long enough to be of sufficient value.

Army representative assigned last year was recalled by the military after serving only six months. An Air Force representative is now attached to the staff and, under original plans, a Navy representative would have followed.

House Armed Services Committee is set to vote this week on legislation that would ban former officers from dealing with the military establishment for two years after they leave service. The measure, an outgrowth of lengthy hearings by an investigating subcommittee headed by Rep. Edward Hebert (D.-La.), seems sure of approval by the full committee.

Meanwhile, House Legislative Oversight Subcommittee headed by Rep. Oren Harris (D.-Ark.) is scheduling hearings on possible conflict-of-interest legislation applicable to Civil Aeronautics Board and other quasi-judicial regulatory agencies. Initial hearings will get under way this week.

CAB Vacancy

Chances are strong that a Civil Aeronautics Board staff member will be elevated to fill the Board membership expected to be vacated by James Durfee who has been nominated as Associate Judge of the U.S. Court of Claims. Durfee's Board term expires Dec. 31, and White House opinion is that the possibility of attracting someone outside the Board to fill so short a term is slight.

Meanwhile, Durfee's Claims Court nomination has been reported favorably by the Senate Judiciary Committee over the vigorous opposition of Sen. William Proxmire (D.-Wis.). Proxmire, however, has shown no signs of relenting in his opposition, plans "to spell out my opposition to him in very considerable detail when his nomination comes up" on the Senate floor.

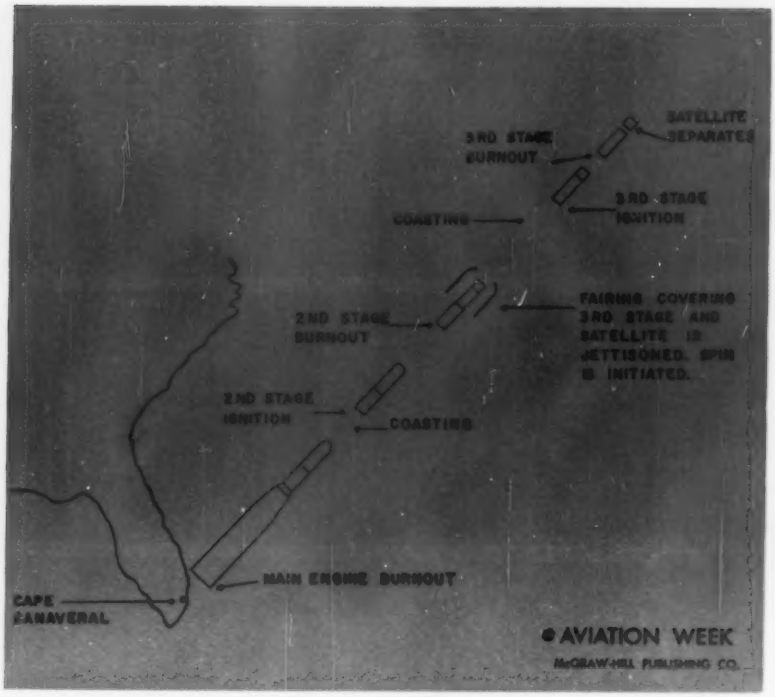
Although discouraged by lack of airline support, Sen. A. S. Mike Monroney (D.-Okla.), chairman of the Senate Aviation Subcommittee, plans at least one more try in his effort to enact legislation authorizing government-guaranteed loans to spur development and purchase of modern jet cargo aircraft. Monroney says his first step will be an attempt to get the subcommittee to report the bill out. Next step—speeches from the Senate floor.

Wrapup

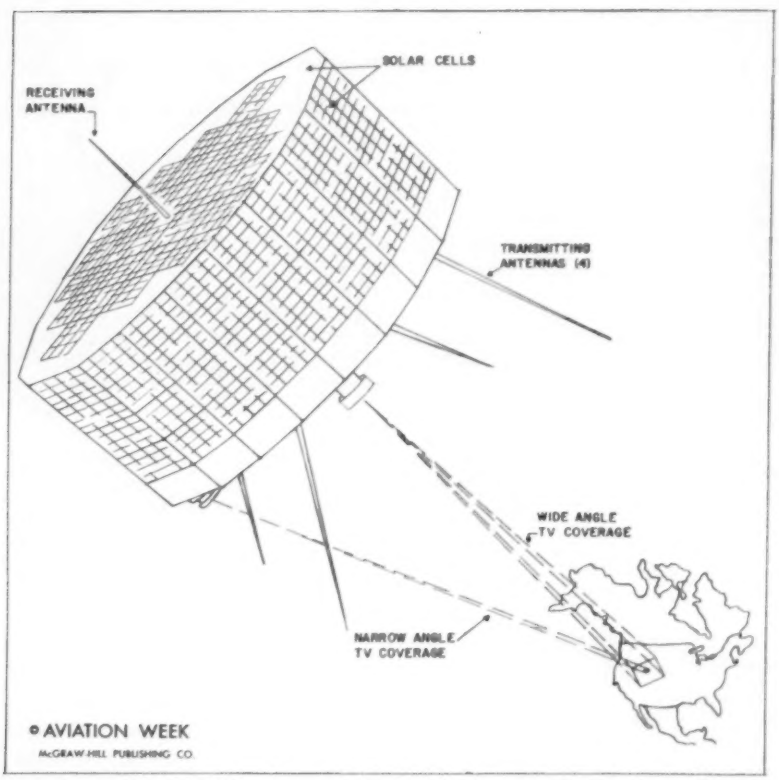
Joint Congressional Atomic Energy Committee's Research and Development Subcommittee will begin week-long hearings on Mar. 22 on "frontiers in research." . . . House Committee on Science and Astronautics has daily hearings scheduled through the remainder of March on the President's proposals to amend the National Space Act. . . . Legislation giving the President broader powers in taking possession and assuming control of transportation systems in national emergencies was recommended last week by Air Force Secretary Dudley Sharp in testimony before a House Subcommittee on National Military Airlift.

—Washington Staff

Tiros I Will



AFTER SEPARATION from third stage, Tiros satellite will reduce spin from an initial rate of 120 rpm. to 12 rpm., angular speed low enough to permit taking pictures with cameras.



TIROS meteorological satellite will scan cloud cover with two television cameras, map earth heat with infrared sensor. Wide-angle TV camera will cover 800-mi.-square earth area.

Washington—First comprehensive scientific weather-eye satellite, Tiros I, specifically designed to probe secrets of cloud cover and earth heat is scheduled to be launched this month from Cape Canaveral.

This meteorological platform, with photographic and infrared-scanning capability, will be orbited to evaluate the validity of existing weather theories and prove principles of weather-satellite design. A second vehicle—Tiros II—is planned for launch in August (AW Nov. 9, p. 26).

In its basic role, Tiros will influence the pattern for advanced approaches to precise weather prediction—a scientific input which undoubtedly will buttress future commercial and military aerial and space capability.

Tiros meteorological satellite system is under the cognizance of National Aeronautics and Space Administration, also the system manager. The satellite is being developed for the national space agency by Radio Corp. of America's Astro Electronic Production Division under technical direction of Army Signal Corps' Research and Development Laboratory.

Scientific aspects of the program are:

- **Tiros I,** a relatively sophisticated vehicle, considering the present state of the art, will scan from a circular orbit 400 naut. mi. above the earth.
- **Two television cameras** will photograph cloud cover in a relatively wide north-east belt extending approximately from La Paz, Bolivia, to Montreal, Canada, (approximately 50 deg. N latitude to 15 deg. S) as the satellite passes over the American continents.
- **Square area** 800-mi. on each side will be the projected field area on earth for the wide-angle television camera in the satellite.
- **Narrow angle, high-resolution** television camera will focus on a relatively small area within the 800-mi.-square area.
- **Infrared detectors** in the satellite will scan the earth to accumulate data for the formulation of a global heat map. The infrared detectors, as well as the television cameras, will scan through the bottom surface of the satellite.
- **Orbit period** will be approximately 100 min.
- **Satellite life** will be about 90 days.
- **About 1,300 orbits** will be made before the satellite is "killed" at the end of its 90-day useful life—its beacon transmission will be terminated by coded command tone. If the transmitter should be halted inadvertently by command it will be reactivated when a playback tape signal or direct picture tone is received by satellite.

Scan Cloud Cover, Earth Temperature

• **Satellite will weigh 270 lb.**, and will include complete facilities for filming, taping and communications.

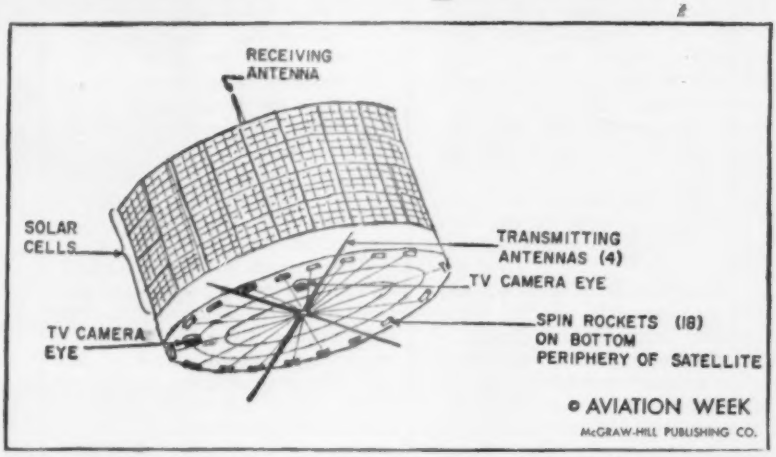
• **Satellite configuration** is roughly cylindrical, with 18 flat sides. Diameter is approximately 42 in., height about 19 in. Four antennas on the bottom surface will transmit signals to the ground. A single antenna protruding from the center of the satellite top will be the receiver.

• **Total of 9,000 solar cells** deck the satellite sides and top. Cells are mounted in a series arrangement in groups of five on printed-circuit boards, each accommodating 80 cells. Minimum efficiency of the cells, using a self-cooling coating, will be about 7%. Average power for instrumentation is 18 watts, supplied by the solar cell power in combination with the bank of storage batteries.

• **Rocket vehicle** is a Thor-Able type, with Air Force's Ballistic Missile Division-developed Thor booster (150,000 lb. thrust), Aerojet-General liquid-propellant AJ10 (7,600 lb. thrust), and Allegany Ballistic Laboratory X248-A7 solid propellant rocket (3,050 lb. thrust) for the third stage. Launch azimuth will be 44.5 deg., inclination will be about 51 deg.

After booster cutoff there will be a coast period followed by second stage ignition and separation from the booster. Coincident with second stage burnout, the fairing covering the third stage and the satellite will be jettisoned, and the vehicle will be spun to 120 rpm. After a coast period, the third stage will be ignited and after burnout will separate from the satellite. After approximately 10 min., when the satellite will be in its first orbital pass, its spin rate will be reduced to about 12 rpm.

This will be necessary because at 120 rpm. the angular speed will be too high for the television cameras to "arrest the view." Slowdown to 12 rpm. is achieved with a "yo-yo" device—a pair of 180-deg.-apart, cable-attached masses which are extended by centrifugal force radially from the satellite. When proper rotational speed is reached, the masses are released by firing of squibs.



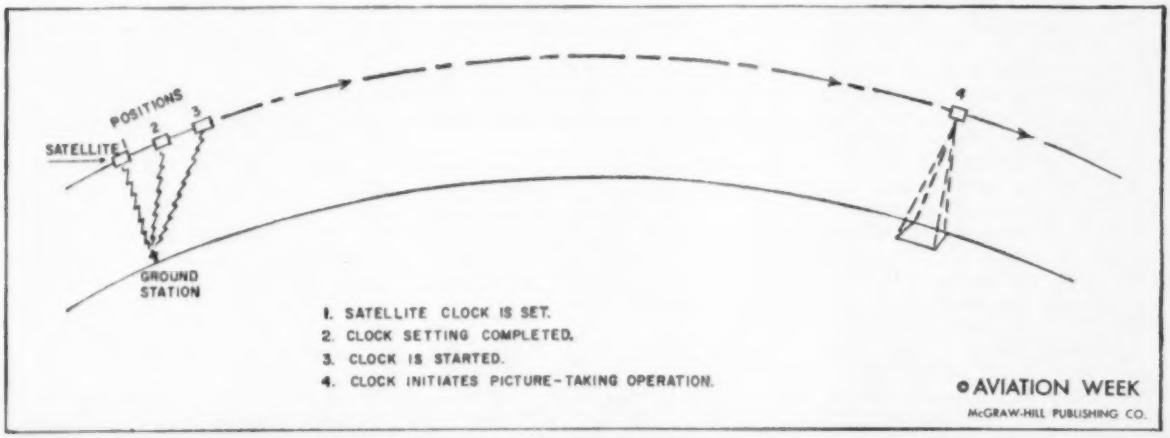
TIROS baseplate will mount 18 small solid-propellant spin rockets. Periodic firing by ground command will restore satellite to desired 12-rpm. rate from 9 rpm. decay rate.

Approximately every 20 days spin-up will be required from a decayed rate of about 9 rpm. to the 12 rpm. required. This will be done with 18 small (1.4 lb./sec. impulse) solid-propellant rockets mounted in diametrically opposed pairs on the satellite baseplate. Spin rocket ignition will be accomplished by command signal from the ground station.

Television cameras will photograph cloud formations over large areas of the earth within a very short period, since orbital time will only be 100 min. Cloud patterns observed will reveal information on wave cyclones, hurricanes and specific cloud formations.

Because the satellite is spin-stabilized with spin axis fixed in inertial space, areas of earth which can be seen will be limited, since the television cameras will look at the earth only during a small portion of each orbit. But, because position of successive orbits will change in relation to the earth as a result of the latter's rotation, a relatively continuous coverage in a wide swath will be obtained from a sufficient number of orbits.

Since the television cameras will be oriented to look toward earth during daylight hours, operating periods will be able to be programed when conditions are proper. Photographs will be transmitted directly to earth during the time when the satellite is within communication range of the receiving station—a period varying roughly from 6 to 12 min. Time required for readout will be 3½ min., with the remainder available for direct reception of pictures. When the satellite is outside of communication range, the television data



SATELLITE is alerted for TV camera scanning with clock mechanism activated by ground station command.

may be stored on magnetic tape for transmission at a later time.

Two types of position reference data will be supplied directly from the satellite. Its rotational position with respect to the sun will be measured nine times during each revolution by solar cells located every 40 deg. around the satellite circumference. Also, an infrared detector in the satellite will sense the crossing of the earth's horizons moving through space.

Cloud cover information will be recorded on tape at ground stations, then flashed on a screen from which it will be photographed.

One set of films from each pass will be processed precisely at the Naval Photographic Interpretation Center.

Both television camera system installations are similar except for the specific optical systems. Each camera will function as an independent unit and failure of one will not affect the other. Information from both cameras will be transmitted in sequence to one ground television receiving station.

Camera Specifications

Camera frame size is ¼ in. x ¼ in. Each camera has 500 lines per frame, speed is one-half frame per second, shutter speed is 1.5 milliseconds, video band width is 62.5 kc. and power consumption is 9 watts. The wide-angle camera has a lens speed of *f*. 1.5, narrow angle camera is *f*. 1.8.

The satellite will be programed for a succeeding orbit while it is within range of a ground station. Pulses received by the command receiver will establish the time interval to start a clock in the satellite and also start the clock "alarm," which will trigger the picture-taking operation. Maximum interval which can be programed between "start" and "alarm" signals is five hours.

In operational sequence, the ground station will send a command signal to the satellite at some specific point in orbit to set the clock. A short time later the clock-setting phase will be complete, and in a succeeding position in orbit the clock will be started. At still another predetermined successive orbital position, with the distance traversed dependent upon the satellite speed, the clock will signal the "alarm" and the cameras will begin to scan.

With its infrared sensor system the satellite will map the relative temperatures of the earth below the orbit. This will provide new data on the earth's heat balance as well as that of specific regions, also will show water vapor distribution and its horizontal movement.

Heat mapping will be recorded on tape and therefore will be continuous. Readout will be during contact with a ground station but only the last 100 min. (maximum tape-reel time) of scanning before readout will be returned during each contact with the ground. This period coincides approximately with the time for one complete orbit.

The data received at the ground station will be recorded on tape and will be reduced for analysis by the Army Signal Corps.

Infrared equipment for heat radiation measurement will encompass two types—a simple infrared non-scanning sensor which will measure two spectral ranges, and a second scanning sensor which will afford relatively comprehensive information by measuring five spectral ranges.

Oriented mostly toward the sun, the top surface of the satellite will be the hottest area. Because of its large area-to-mass ratio, the top will tend to become too hot during the daylight portion of its orbit and its radiation characteristics will be insufficient, requiring that some of the heat be dissipated to protect instrumentation.

Conversely, the bottom surface of the satellite will have a tendency to become relatively cool, hence heat energy dissipated by the satellite components will be conducted to the baseplate, cooling the relatively hot units in the satellite and heating the bottom surface of the satellite, to equalize the temperature of the over-all payload. Keyed to this, the structural design of the satellite is projected to give the maximum possible interchange of radiant energy in the interior. Sing'e-thickness, segmented side-skin is electrically insulated from the top surface. Baseplate is a single-thickness stiffened skin for minimum thermal resistance to satellite interior.

Ground Stations

Entire operational phase for Tiros I will be directed from NASA's Space Operation Control Center. Primary centers with command control and data readout functions in the ground station chain will be Army Signal Corps' Ft. Monmouth, N. J., site and Lockheed Missile and Space Division's Kaena Pt., Hawaii, station. The satellite will be in contact with these stations once during each orbit, except for three or four orbits each day. Backup stations will include NASA's Cape Canaveral, Fla., facility and the RCA site at Hightstown, N. J.

Millstone Hill radar station in Massachusetts will pinpoint the position in the trajectory where the satellite enters its orbit.

Monitoring the stations at Kaena Pt. and Ft. Monmouth, meteorologists from the U.S. Weather Bureau, Air Weather Service, Navy Research Weather Facility, Air Force Cambridge Research Center, Army Signal Corps and Allied Research Associates will perform real time data analysis for transmission to a central station.

Data for computation of the satellite's spin axis attitude will be noted by attitude data recorders at specific Minitrack stations—probably selected from those at Lima (Peru), Quito (Equador), Santiago, (Chile), Ascension Island (South Atlantic) and Goldstone facility (Calif.).

Stations in the Minitrack network will track the satellite, send position and attitude data to NASA's computation center, where future orbits will be calculated and preparations made to program the satellite for succeeding acquisition and tracking. This programing also will determine which areas will be selected for photographing with the television cameras.

A communication network will tie the control center with all tracking stations and support sites.

Tiros Satellite

NASA's Tiros meteorological satellite will afford an 800-mi.-square view of the earth coupled with a small high-resolution picture within this area.

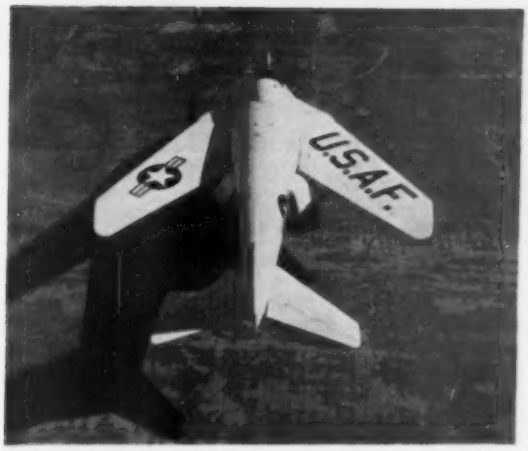
It highlights picture-taking potential from space and brings into focus the international ramifications of earth surveillance, even before USAF's WS-117L Samos photographic reconnaissance satellite, the Midas early warning satellite or any comparable Soviet payloads have been orbited.

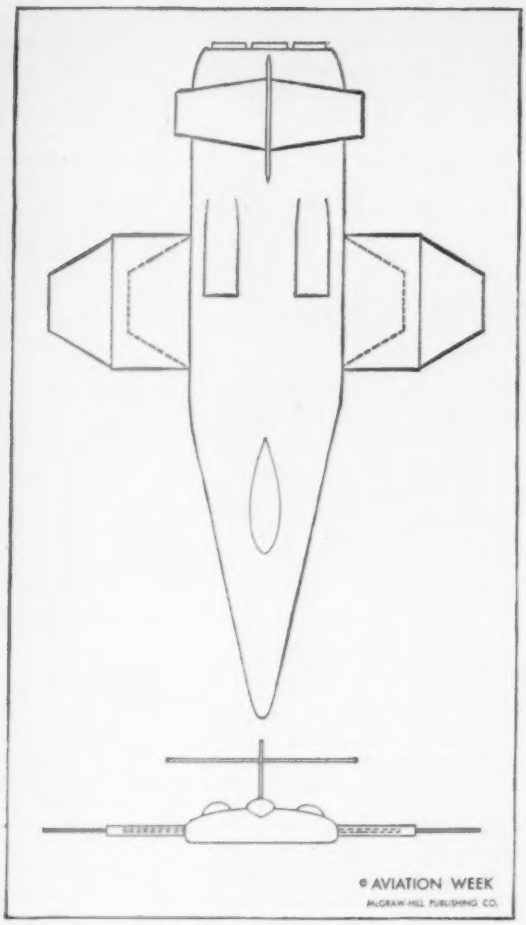
A satellite with photographic or infrared capability passing over national areas conceivably could raise questions of international law, just as the flight of any aircraft over national boundaries now does. The situation is, however, becoming an academic one because of the infinite boundaries of space and the scope and type of observation possible—both by instrumentation and spacecraft crewmen.

Tiros, with its television cameras for cloud cover observation and infrared sensors for earth-heat mapping, is only one satellite in a succession of "viewers." Soviet Sputnik instrumentation capability is not completely known, but easily could have included scanners. Lunik III incorporated camera capability, took moon far-side pictures in the course of its orbit around moon and earth and easily could have transmitted pictures of earth as well.

USAF's Explorer VI satellite returned pictures from a television-type camera as it orbited the earth in a long elliptical path. Atlas-Able IV lunar probe, which failed in flight, also was fitted with an identical television scanner.

These and successive experiments are underscoring the need for a continuing appraisal of international law as it relates to space excursions.





FLIGHT test data on variable sweep wings has been available for almost 10 years with Bell X-5 (left). Variable wing area (see drawing) could aid in design of STOL with good takeoff characteristics and high-speed sea-level capability.

USAF Drops Mach 2 VTOL for STOL

Washington—Air Force plan to develop a Mach 2 VTOL fighter (AW Feb. 1, p. 38) is being scrapped and replaced with a requirement for a 3,000-ft. takeoff STOL aircraft at the insistence of Tactical Air Command.

Operational VTOL aircraft for the Air Force have been pushed back into the early 1970 period and have re-entered the study phase because TAC does not believe that the Air Staff and Air Research and Development Command plan to develop them for use in the mid-1960s is realistic.

As usual, the differences of opinion about the feasibility of VTOL aircraft revolved around the performance of available engines.

In this case, however, there apparently is as much argument for the Mach 2 VTOL aircraft as there is for the TAC STOL fighter.

The new TAC requirement calls for a range of several hundred miles while operating around Mach 1 below 1,000 ft. altitude. The high fuel consumption of current jet engines at sea level makes this performance more difficult, in the opinion of many engineers, than vertical takeoff and landing for a Mach 2 aircraft that stays at altitude during most of its mission.

Tactical Air Command also has strong doubts about getting the support systems developed within five years that are necessary to operate a VTOL aircraft with proper dispersal.

Major Questions

This program reversal after several years of Pentagon planning for an operational VTOL tactical aircraft around 1965 reflects three of the major questions facing the Air Force today. These are:

• **Should the authority for** development of new weapons be placed with operational commands or with service research and development organizations?

• **How is the present technical** confusion over the feasibility of VTOL aircraft to be resolved? The performance of these vehicles can be so contradictory on paper that it is possible to defend almost any opinion.

• **Is TAC becoming too heavily** oriented toward the delivery of large yield weapons at the neglect of its close support mission of troops in both limited and all-out war? Many Air Force and Army officers believe the Army may have a case for operating its own close support aircraft if all of TAC's future equipment is obviously intended for strategic missions and can operate only from large prepared airfields.

The Mach 2 VTOL fighter development effort received the support of the offices of the Air Force Deputy Chief of Staff for Operations (DCS/O), the Deputy Chief of Staff for Development (DCS/D) and the Air Research and Development Command until the end of January. This was an accelerated program to try to take advantage of an offer of Department of Defense Fiscal 1960 funds earmarked solely for development work leading to an opera-

tional VTOL aircraft. Industry design proposals had been requested, and it was hoped that a development plan could be completed, contractors selected and work begun by July 1.

The Air Force groups pushing the program were operating under a new set of procedures for generating requirements that had been placed into effect last summer. Under this system, the Deputy Chief of Staff for development has the responsibility of establishing System Development Requirements (SDRs) to meet either "a long term operational capability or to exploit militarily a new technological advancement." If the feasibility of a system is proven by work authorized under the SDR, it is the responsibility of the Deputy Chief of Staff for Operations to bring it into the Air Force's short-term planning picture by creating a Specific Operational Requirement (SOR). Short-term planning involves systems "which can be met within present technical capabilities and placed in early production." A number of other documents are used by the office of the Deputy Chief of Staff for operations in preparing an SOR. One of these is a qualitative Operational Requirement (QOR) which is submitted by field commands to express their views on new and improved equipment.

Former System

Only one type of document, the General Operations Requirement (GOR), was used in the old Air Force requirements system to cover both short- and long-range needs and there had to be a formal GOR before any development work could be initiated.

The new requirements generating system was established somewhat along the lines suggested by Air Force's Scientific Advisory Board to place the authority over weapons development with the development commands. Reasoning here was that technical change has become so rapid that only properly trained people who work with research and development problems on a day-to-day basis could keep abreast of the weapon system implications of modern science.

In practice, however, it has been difficult to break away completely from the old requirements system in which the operational commands were expected to have more influence on the selection of weapon systems. In the recent tactical aircraft policy change, development implementation of SDR-12 covering the Mach 2 VTOL fighter was stopped and SDR-17 for the 3,000 ft. takeoff STOL aircraft was drafted within a matter of a few days after TAC headquarters made its position forceably clear. Development plan for SDR-17 is due back from ARDC during April, and a design competition to select a contractor will be held shortly afterward, according to present plans.

The Defense Department funds offered the Air Force for the operational Mach 2 VTOL will be available for the STOL airplane and, in view of the successful talks between TAC and Defense Department officials, the funds may be increased. Tactical Air Command originally pushed for a Specific Operational Requirement for the STOL aircraft which called for early production, but it was suggested by the Defense Department and other groups that the original financing could be handled more expeditiously under an SDR. TAC headquarters hopes to have the STOL aircraft in squadrons around 1965, with a VTOL fighter following about 1970.

It has been possible with current engines, structural practice and aerodynamic knowledge to prove experimentally that several types of vertical takeoff and landing aircraft are feasible. Considerable flight time has been gathered on some of these aircraft, and they have shown good transition qualities from vertical to horizontal flight and vice versa. This flight experience also has shown that even the most successful of the VTOL research aircraft are underpowered and that, in their present state of development, there is ample room for doubt as to their feasibility.

Most U. S. military and airframe company engineers apparently believe the best way to remove this doubt is to go through another round of turbine engine research and development. The major objective of this program would be to raise the engine thrust-to-weight ratio from the present high figure of about 8 to 1 to the neighborhood of 12 to 1. Such an ambitious engine program would be extremely expensive, and it is doubtful whether the VTOL program could command the required funding support at this time in the face of missile priorities, etc., although it is the key to eliminating large, vulnerable airfields for manned aircraft.

Means of overcoming this obvious budgetary hurdle is being given much thought by all three military services and by the aircraft industry. Two broad methods apparently are being given the most consideration:

• **Pursuit of joint aircraft** development programs by the services on a larger scale. This procedure is favored by both the technical and fiscal authorities in the Department of Defense. One of the most likely ventures of this type is a joint Army-Navy development of a VTOL assault transport. The specifications of the two services for this aircraft are relatively close, and turboprop engines, which probably would be used, are the best of any available type for VTOL application.

There has been some speculation that TAC also may ask to purchase a Navy-developed aircraft such as the McDonnell F4H or the North American A3J to tide it over during the middle 1960s if its present plans for an STOL fighter do not materialize. Purchase of a developed aircraft would make its equipment dollar go farther and increase the probability of the command getting as many operational aircraft as it asked for.

• **Renewing the effort to design** a VTOL or true STOL attack aircraft, which would not be marginal, using available engines. It is felt by some aircraft companies that ingenuity and departure from conventional design could pay large dividends in this area. Some engineers feel it may be possible to meet TAC's STOL fighter specifications, although they are generally considered to be extremely stringent. If this cannot be done, they believe there is a possibility of achieving a design that would be good enough to persuade TAC to alter its requirements to some degree.

Major Design Problem

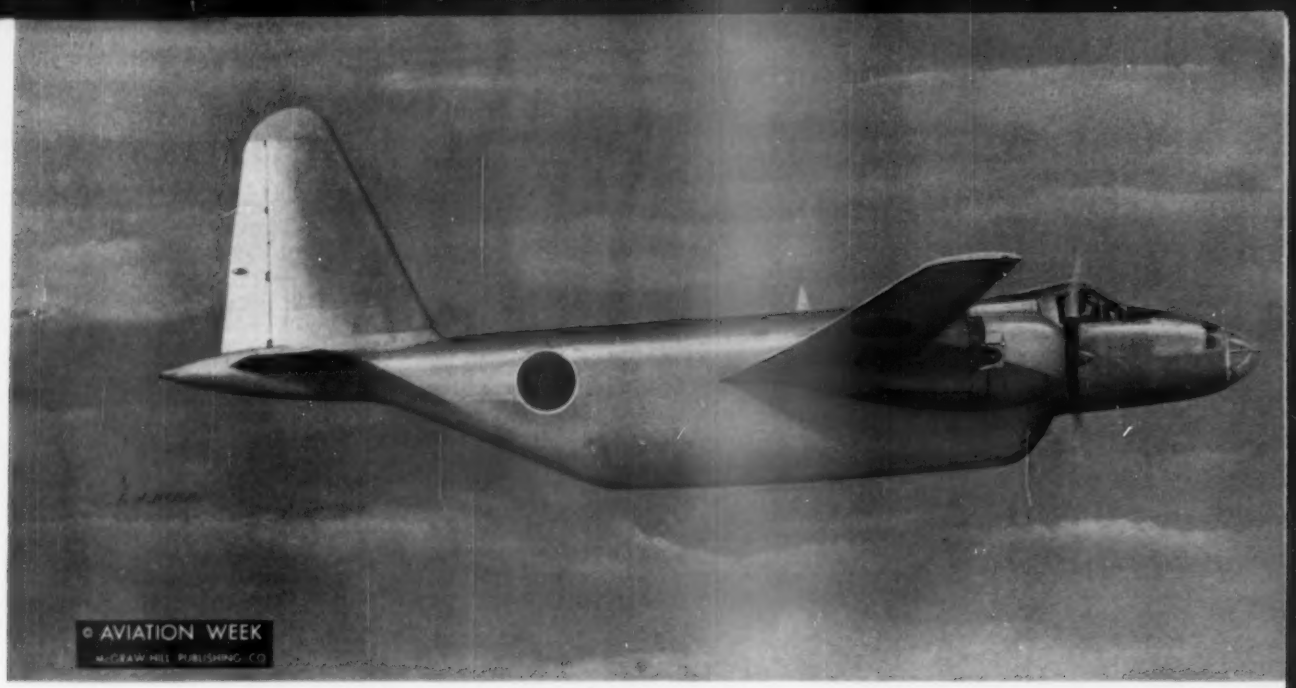
Over-all performance that TAC wants in a STOL fighter leads to one major design problem that has been discussed in general terms in engineering reports by the National Aeronautics and Space Administration and several aircraft companies.

The problem is wing sizing. Short takeoff requires a large, efficient, highly-cambered wing. This wing contradicts the requirement for flying at low altitudes over long distances and at high speeds. NASA reports indicate that the most efficient vehicle for flying at transonic speeds or higher at sea level will have no wings at all. If a low-level wingless aircraft is ever used for high altitude cruise to get maximum range, using any given engine and fuel load, it would be heavily penalized for its lack of wings. Long-range ferry performance with a minimum of in-flight refuelings is a rigid requirement for TAC aircraft which must be able to deploy quickly to any

Dyna-Soar Study

Washington—Boeing Airplane Co. is scheduled to present analyses of Project Dyna-Soar's vehicle-booster compatability to the Scientific Advisory Board later this month.

Space Technology Laboratories is supplying Boeing with booster data for use in the presentation. Reason for STL's inclusion in the project was an Air Force decision to temporarily curtail the Martin Co.'s participation in the Dyna-Soar program until Titan ICBM management difficulties (AW Dec. 14, p. 27) are resolved. STL is performing systems engineering and technical direction for the Titan weapon system for USAF's Ballistice Missile Division.



Japan Plans Lockheed P2V-7 Transport Version

Kawasaki Aircraft Co., which has begun production of the Lockheed P2V-7 under license, also plans to build a transport version of the patrol aircraft as a possible Curtiss C-46 replacement for Japan's Air Self Defense Force. Transport version (above) would incorporate an essentially new fuselage with a rear landing ramp. Cargo capacity would be approximately 16,000 lb.

point on the globe. It is almost impossible to provide acceptable performance in any of these flight regimes—high speed at sea level, takeoff or ferry flight—if the wing design is compromised to accommodate any of the others. The unusual designs considered today as possibly offering a means of satisfying the TAC STOL requirement include the following:

• **Variable sweep wings.** These offer greatly improved aerodynamic performance over a wing with a fixed degree of sweep. Takeoff performance can be good with these wings, while the drag coefficient at high speed can be lowered significantly if sweep angles of better than 45 deg. are possible. The Bell X-5 variable sweep research aircraft has been tested for years by NASA and its predecessor, the National Advisory Committee for Aeronautics. Highly placed NASA engineers believed this design was good when the X-5 first flew, and they still think it could be used to build a superior STOL aircraft. Weight of the sweep change mechanism is critical with this design, which also has some stability and control problems.

• **Variable wing area.** This idea has not been tried experimentally in the U.S. since the 1930s. Theoretically, it is an ideal solution to TAC's STOL requirement. Doubts as to the feasibility of this design primarily involve the elaborate mechanical system required. One straight wing configuration with a wide flat-bottomed fuselage which would tend to simplify the mechanical system is shown on page 29. The outer portions of this wing would use a very thin high speed airfoil section. The inboard portion, which retracts into the fuselage, could have a thick, highly cambered airfoil suited primarily for landing. A large flap could be used on the inboard section which probably would be set at a much higher angle of incidence than the outboard panels. Aerodynamic stability troubles as well as mechanical problems apparently could be kept to a minimum with the straight wing design. If anyone should design an aircraft that was not completely symmetrical, the amount of retractable wing area could be doubled by placing one wing slightly above the other so that one passed over the other as the two were drawn into the fuselage.

• **Droppable wing panels.** A number of companies in the past have considered using large outer wing panels that could be dropped off the aircraft after it reached a certain flight speed. The wing area left would be sized for a high speed, low level mission and for landing at a low gross weight. Apparently TAC is not interested in such schemes because of the maintenance and supply problem with the wing panels regardless of how ruggedly they are built. Tactical Air Command also has rejected rocket and jet-assisted takeoffs as a means of achieving STOL or VTOL takeoff with a very small wing. Supply problems dictated this TAC position.

Apparently, there is a large group of military officers in all three services who believe that two distinct types of tactical aircraft will be needed on an atomic battlefield several hundred miles deep. One of them is represented by the current TAC STOL requirement, which can be based outside of the battle area and yet cover most targets there, as well as many of those in the enemy's rear, with large nuclear weapons. The other type of aircraft required would be slower and based in the battle area or close behind so that it could rise quickly and attack small point targets with light nuclear or high explosive weapons. It would be mandatory that this relatively light aircraft have VTOL or true STOL capability from unprepared fields.

Army Argument

Officers who feel that this light tactical aircraft is needed also believe the Army could win the right to operate them in the near future if the Air Force neglects the requirement. The argument is that the Army does not want to rely completely on missiles and artillery for close support firepower while completely ignoring the capabilities of manned aircraft any more than the Air Force wants to do away with manned aircraft and switch completely to missiles for its strategic bombardment.

The most ardent backers of an early Army move to get into the close support tactical aircraft business point to the Grumman AO-1 Mohawk as a good first aircraft for this job. The Mohawk has approximately the same power-to-weight ratio as the F8F Bearcat, and it has been designed to carry a heavy load of reconnaissance gear for which weapons could be substituted.

New Agency May End STL Controversy

Washington—Solution is imminent in the long-smoldering controversy on the contractual relationship of the Air Force Ballistic Missile Division and Space Technology Laboratories.

Government officials and industry contractors are expecting a sweeping decision from Air Force Secretary Dudley C. Sharp establishing new, firm guidelines for Ballistic Missile Division contractor relationships, in effect, a broad operational reorganization which, incidentally, will set the pattern for STL's participation in present and future programs.

Sharp's decision undoubtedly will be based upon a report of the Millikan Committee, which has analyzed in a four-month study the management aspects of the Air Force's ballistic missile and space programs, with particular emphasis upon USAF's in-house capability—the degree of capability now possessed and what it should be for future weapon systems.

The committee's report has been on the Air Force Secretary's desk since the end of February.

Two Key Changes

Two key changes which Sharp's decision likely will effect in the reorientation of Air Force and STL participation in the ballistic missile program are:

- **Nonprofit corporation** will be established by the Air Force to take over some specific functions now performed for BMD by STL (AW Mar. 7, p. 327). The new nonprofit corporation probably will be constituted to conform to the structural concept of Air Force nonprofit corporations such as MITRE (communication and control integration for the air defense system) and RAND (long range studies).
- **STL will continue in** its existing corporate status, operating for profit as a wholly-owned subsidiary of Thompson Ramo Wooldridge, competing with other industry members for ballistic missile engineering contracts. This competitive status probably would be applicable to future Air Force weapon systems, with the probable specific exemption of Atlas, Titan and Minuteman ICBMs, simply because it would be impractical to cancel and put out for re-bid the systems engineering and technical direction of these programs in their present state of development. The new Air Force-owned nonprofit corporation would not have systems engineering and technical direction in-house capability—at least not in the initial phase of its corporate existence.

Question of retention by STL of other engineering functions it now performs through BMD—systems engineering and technical direction for a communication satellite project and for booster phase of Project Mercury—may not yet be settled.

Millikan Study

This new status for the Air Force ballistic missile and space programs had its beginning last fall when the Millikan Committee began its analysis by discussions with key personnel from various groups—Air Research and Development Command, Air Materiel Command, Space Technology Laboratories, Thompson Ramo Wooldridge and major industry companies—for viewpoints as to how the Air Force should conduct its programs in the future, whether the ballistic missile program had improved or deteriorated and an airing of particular grievances regarding the ballistic missile and space program. Questions were extensive and penetrating.

In the course of the committee's investigations, it probably became apparent that some of the problems initially posed as militating against the continued BMD-STL relationship were really not key factors. One of these was the ownership of STL by Thompson Ramo Wooldridge, which had led to pressure from the Air Force and industry for divestiture of STL by the parent company. Apparently, it appeared to the Millikan Committee that the same situation would exist if STL had been purchased from Thompson Ramo Wooldridge by another industry member. The House Government Operations Committee had felt that, in the USAF-STL-Thompson Ramo Wooldridge relationship, government and private business values had become intermingled to the detriment of both (AW Sept. 14, 1959, p. 146).

Question of STL becoming a nonprofit organization to continue the discharge of both its staff and line functions for the Ballistic Missile Division probably never was seriously entertained by the majority of key personnel at STL.

Interest of the committee apparently shifted to feasibility of developing an in-house capability for the Air Force's ballistic missile and space programs. This line of investigation may have been stimulated by an admission by Lt. Gen. Bernard Schriever, then ARDC commander, that the in-house capability, after five years of missile management effort, resided with STL, not with the Air Force.

STL Services

The situation was analyzed to see which of the functions Space Technology Laboratories was presently performing for the Air Force should be a USAF in-house capability. For an adequate decision on this capability, the committee examined the functions performed by STL for the Ballistic Missile Division.

Staff functions performed by STL include:

- **Administrative services.**
- **Fundamental laboratory research.**
- **Advanced planning.**

Line functions performed by STL for BMD include:

- **Systems engineering** and technical direction.
- **Experimental space flight** programs such as Air Force's Able projects.

Systems engineering and technical direction probably came in for the closest scrutiny. Initially, this function probably was considered unique, primarily because it encompassed all of the missiles in Air Force's ballistic missile program—Atlas, Titan and Minuteman ICBMs and the Thor IRBM, which has now been phased out of BMD's development program.

Actually, since the systems management concept was implemented by the Air Force, the systems engineering and technical direction type of operation

Millikan Committee

Washington—Following are members of the Millikan Committee which surveyed Air Force's ballistic missile management program:

- **Dr. Clark B. Millikan, chairman, director of Guggenheim Aeronautical Laboratory, California Institute of Technology.**
- **Dr. Hendrik W. Bode, vice president Bell Telephone Co.**
- **Malcom P. Ferguson, president, Bendix Aviation Corp.**
- **Robert L. Hamill, partner, Sanderson & Porter, Inc.**
- **Dr. Lawrence A. Hyland, general manager, Hughes Aircraft Co.**
- **Roger Lewis, executive vice president, Pan American World Airways, and former assistant secretary of the Air Force.**
- **Charles A. Lindbergh, Brig. Gen. USAF reserve, member of Air Force Scientific Advisory Committee.**
- **James McCormack, Maj. Gen. USAF (ret.), vice president, Massachusetts Institute of Technology.**
- **Dr. Jerome B. Wiesner, professor of electrical engineering, Massachusetts Institute of Technology.**
- **Dr. Emanuel Piore, research director of International Business Machines Corp.**

has been performed by industry. Much the same type management is performed by industry members such as North American Aviation with the B-70 and Convair with the B-58.

Award to Space Technology Laboratories of this systems engineering and technical direction responsibility without competition also probably was not considered unique in Air Force history. Uniqueness may have resided in the prohibition against manufacturing by STL.

Basic view began to develop that the staff functions—administrative services, fundamental laboratory research and advanced planning—should be contracted by the Air Force to a nonprofit organization, and that the line functions—systems engineering and technical direction and conduct of experimental flight programs—should be contracted to industry. (Some fundamental laboratory research also may be a line function.) This general approach apparently coincides with Air Force's and Space Technology Laboratories' views at this time.

It's unlikely that the committee has recommended, or that the Air Force will agree, to sever STL's systems engineering and technical direction services in relation to existing ballistic missile programs, because of the delay involved in such action, coupled with the expense of contract termination and assembling a comparable capability in another contractor.

On new ballistic missile projects, the Air Force will have to decide whether to establish competitions for systems engineering and technical direction on the basis of selecting a single prime contractor or select a contractor with the prohibition against manufacturing. In either case, STL could compete in the same manner as any other company. If manufacturing were permitted, however, STL probably would not want to compete with other industry members in immediate future systems since for a considerable period its approach probably would remain oriented toward research, development and engineering activities with no manufacturing.

It is considered a certainty that, if and when the Air Force cancels its contract with STL for staff functions and re-establishes this contract with the new nonprofit corporation, STL will permit USAF to recruit staff-function personnel from its technical staff to form a basic cadre.

This staff-function group at Space Technology Laboratories is the smaller part of its technical staff—probably not more than 20% of the 1,500 total technical staff members. It's unlikely that STL could support this group of staff-function personnel if the staff function were separated from STL activity.

One aspect of the program management reorientation which poses a major question mark is whether personnel now holding key positions in STL's staff-function activity would be willing to transfer to the new nonprofit corporation. It is likely that many of the STL staff in this function, such as in the Advanced Planning Group, may desire to become affiliated with the nonprofit organization.

Salary ranges should be no limitation since civil service ceilings would not apply.

Question of facilities for the new nonprofit corporation and the staff on the Ballistic Missile Division and its associated Ballistic Missile Center of the Air Materiel Command will be a critical consideration. The BMD/BMC activity probably will want to remain in its present location in Inglewood, Calif., with the new corporation located nearby.

All buildings but two in the BMD/BMC complex of 13 buildings are now owned by Space Technology Laboratories, with the Air Force occupying its portion under the administrative services arrangement which Space Technology Laboratories now renders. Air Force may want to purchase some of these STL facilities as a result of the management reorientation, as well as some of the nine buildings STL now occupies in El Segundo, Calif., for its research and development division. Air Force purchase of these facilities would require congressional action.

Sharp Decline in Net Earnings Reported by United and Boeing

United Aircraft Corp. and Boeing Airplane Co. reported last week that net earnings for 1959 slipped substantially below 1958 levels.

United's net income declined from $42,294,728 in 1958 to $28,638,353, while sales dropped approximately 10%—from $1,200,427,387 to $1,080,980,782.

Boeing reported its 1959 net earnings at $12,435,754 as compared with $29,360,013 for the previous year. Sales also slipped slightly—from $1,711,929,576 in 1958 to $1,612,152,754. Net earnings after taxes were 0.77 cents per dollar of sales as compared with 1.72 cents in 1958.

United's 1959 net, after dividends on preference stock, was equivalent to $4.25 a share on the 6,396,457 shares of common stock outstanding at the end of the year. Net for 1958 was equivalent to $6.40 a share based upon 6,372,970 shares.

Unfilled orders held by United at the end of the year totaled about $1 billion, while fixed assets were valued at $288,166,299. Comparable 1958 figures were $1.4 billion and $271,364,985 respectively.

Boeing's unfilled orders at the year's end totaled approximately $2 billion.

In United's annual report, Board Chairman H. M. Horner and President William P. Gwinn attributed the sharp decline in net earnings primarily to company-financed research and development programs. Over-all, the report said, engineering expenditures on projects without government or other customer support are expected to increase from the $28 million level in 1959 to over $40 million this year.

Shipments for 1960, Horner and Gwinn said, "are not expected to be materially lower than in 1959" and should exceed the $1 billion level for the fourth consecutive year. The report added that "it is hoped that the reduction in earnings in 1960 can be limited to the effect, after taxes, of the increased (company-financed) development expenditures."

Boeing President William M. Allen said the decrease in his company's net earnings during 1959 resulted primarily "from the decline in sales volume on military contracts due to transition of the B-52G and Bomarc production programs from a cost reimbursement to a fixed price contract basis and continued heavy charges applicable to the commercial jet transport program."

Allen predicted that 1960 sales will continue at a relatively high level but somewhat lower than that for 1959. Earnings, he said, are expected to improve during the year, "the degree of improvement being dependent on further developments on the commercial program."

In the military field, Allen said "substantial deliveries" under the B-52 bomber and KC-135 jet tanker programs are scheduled for 1960, "although at reduced rates." He added that "deliveries of missiles and bases under the Bomarc program are scheduled for continued build-up throughout the year, and activity on both the Minuteman (solid propellant ballistic missile) and Dyna-Soar (boost glide) programs should accelerate substantially."

The United annual report said the greater part of the increased company-financed engineering expenditures in 1959 cover development of new turbine engines and helicopters "for the field of manned aircraft . . . (which) still has great potential and will account for the bulk of the corporation's sales for the next several years."

Lanphier Warns of Weakening Defenses

Washington—Thomas G. Lanphier, Jr., in his first public appearance since resigning as vice president of the Convair Division of General Dynamics Corp. to crusade for a stronger defense (AW Feb. 29, p. 27), warned Congress last week the U.S. is already in the process of losing World War III.

"We are engaged," Lanphier told the House Committee on Science and Astronautics, "in the only military phase of World War III we have a chance to win; the deterrent phase. And we are losing it. Losing it to the extent that I believe we could now logically assume ourselves to be in jeopardy of physical destruction and likely to remain so for the next three years." Reasons the U.S. is losing World War III cited by Lanphier include:

- **"Lack of a sufficient and timely** intercontinental ballistic missile program.
- **"Lack of a defense against** a submarine attack.
- **"Lack of a weapons program** and policy to deter limited aggression.
- **"Lack of a sufficient** and timely space program.
- **"And above all, lack** of recognition that we are, and have been for a long time, actually engaged in World War III."

Lanphier, who said he relinquished his position with Convair after nine years of service so that he could conduct his campaign for increased military and space effort "without bias," also questioned whether President Eisenhower is receiving complete advice on defense matters or that he is as knowledgeable as he claims.

Here is his response to questions asked by Rep. Erwin Mitchell (D.-Ga.):

- **Rep. Mitchell:** "Do you think President Eisenhower knows as much about defense as he says he does?"
- **Lanphier:** "No sir, I do not."
- **Rep. Mitchell:** "Do you think he is ill advised in the field of national defense?"
- **Lanphier:** "I think sometimes he is not completely advised. For instance, he and some of his advisers said several times that it isn't necessary that we match the Soviet in rocket thrust in the military area, that as long as we have enough to reach the target it is sufficient. . . . He does acknowledge it (extra thrust) is significant in space, but here, or course, we are not in a race, according to him, and, therefore, there is not the extraordinary urgency to get this thrust any sooner. . . ."

Lanphier also told the space committee headed by Rep. Overton Brooks (D.-La.) that President Eisenhower is taking a "dangerous gamble with the nation's defenses" as a result of his policies.

He recalled that three years ago Gen. Curtis LeMay, now Air Force vice chief of staff, told Congress to the effect that unless the U.S. defense program was altered from what was then planned, the winter of 1959-1960 could find the U.S. inferior to the Soviet Union in military power.

"In the intervening three years," Lanphier said, "the only changes in our defense effort have been to diminish it from what it was then planned to be. The Soviets, meanwhile, have led mankind into space with their Sputniks.

"Last spring, along with the rest of the world, I heard President Eisenhower admit by implication that we could not meet the Berlin crisis, if force were required, with any alternative but national suicide.

"This winter, in the defense budget he has proposed to the Congress, I note with disappointment that the President has proposed no significant step toward arming us with a limited war deterrent for use in the continuing crisis over Berlin and other, as yet unforeseen, but certainly potentially limited war situations.

"I note he has again asked for insufficient ballistic missile and manned aircraft to close the growing gap relative to Soviet Russia in the area of massive weapon systems," Lanphier said. "And he has once again read the United States out of the space race while failing to take the simple steps currently possible to better organize the space programs the United States does have under way."

With regards to the space program, Lanphier said the 10-year plan that has been outlined by the National Aeronautics and Space Administration to the House Space Committee "is well considered and makes good sense if not chipped away" by lack of funds. He added, however, that integration and coordination of military and civilian space programs under the present organizational structure does not look encouraging.

To improve the nation's defenses and build a deterrent force that would leave no doubt in the minds of a potential enemy as to its strength would require an additional $4 to $5 billion a year, Lanphier said, offering these suggestions:

- **Change in national attitude** beginning with the President, is needed.
- **Budget should be orientated** toward both the immediate threat and the future.
- **Significant number of Strategic** Air

English Electric Makes East German Deal

Leipzig—Order for three sets of constant-frequency alternating-current generating systems for the proposed Type 155 twin-jet transport has been negotiated between English Electric Co., Ltd., and representatives of East German Democratic Republic's aircraft industry.

Value of the order is about $140,000. Possible purchase of additional seven sets is covered by a letter of intent and a company representative said the order may eventually total 60 units and be worth about $2 million.

Execution of the order now depends on approval by the U. S. Executive Department because one component of the system—the Sundstrand constant speed drive—is currently on the American embargo list. British Board of Trade gave its approval Feb. 29 for export system components on its embargo list.

A spokesman for Volkseigene Betrieb (VEB) Flugzeugwerke Dresden said the Type 155 is only a paper study and he declined comment on the layout. However, most sources agree the airplane is being designed as 30-passenger twin-jet aircraft powered by a pair of East German Pirna 014 turbojets. The plane probably is in the category of the Ilyushin Il-14 replacement which is the logical next step for German Democratic Republic's growing aircraft industry.

An English Electric technical team has been in East Germany for the past nine months, meeting and negotiating with representatives of VEB Flugzeugwerke Dresden. Application for export license was made in early January. Right after the British Board of Trade granted approval to export British components, which are similar to but far from identical to those used in the Vulcan and Victor bombers, the company made application to the U.S. But by last week, U.S. approval had not been received.

Although trade between East Germany and Western bloc countries is increasing, this order probably is a one-time deal and is not believed to mark the beginning of an increasing flow of aeronautical material into East Germany. That country's aircraft industry, although small, is growing and is technically capable. Both native ability and pride will keep the industry as self-contained as possible and will hold purchases from the West, or technical help from the outside, to a minimum.

Command planes should be placed on a continuous airborne alert as soon as possible.

• **More Boeing B-52** and Convair B-58 jet bombers should be ordered to replace those worn out by the air alert.

• **Production of the Atlas** and Titan liquid propellant ICBMs and the solid propellant Minuteman and Polaris ballistic missiles should be accelerated.

• **More airlift for the** Army and Marines to meet any limited war situations.

• **Midas and Samos** reconnaissance satellite programs should be accelerated immediately.

• **Realistic civil defense** program should be initiated.

• **Men of science and industry** should be given better access to intelligence information gathered on similar technological fields from behind the Iron Curtain as well as in the West.

Lanphier said that, because the Administration made the "wrong decision" in not accelerating the U.S. ICBM program to provide sufficient numbers to adequately meet the Soviet threat, he is seriously concerned over the gap that will exist over the next three years until the mobile Minuteman ballistic missile system comes into being. To prevent the retaliatory force from being wiped out in a surprise attack, Lanphier said the U.S. should turn to a continuous air alert for the Strategic Air Command.

"There are those, including myself," he said, "who believe Gen. Thomas Power (SAC commander) is conservative when he estimates it would take as many as three ICBMs to destroy a SAC base and all the retaliatory bombers on it. There are others who argue it would take more. But it is difficult to understand how anyone can argue when he says:

"'We must anticipate that the Soviets may have accumulated a sufficient number of operational ICBMs and intermediate range ballistic missiles for an all-out attack before we have in operation warning systems which could provide reliable and adequate warning of such an attack. We have such systems now under development designed to give some 15 min. warning which would suffice to get most or all of SAC's ground-alert forces airborne. But until our ballistic missile warning system becomes fully operational, SAC's capability to survive a missile attack with little or no warning will be the crux of the free world's deterrent posture.'"

"Yet," Lanphier said, "this winter's budget for our defense does not ask for enough money to keep a significant number of SAC bombers and bombs off the ground and out of the pouncing reach of Soviet ICBMs. An ICBM force which could well be by this time more than the 150 Soviet ICBMs Gen. Power opines would be required to wipe out our retaliatory forces."

Lanphier told the Committee that, if the U.S., at the time of Sputnik I in the fall of 1957, had decided to move ahead faster, it could now have 450 operational ICBMs instead of the few currently available.

Space Technology

NASA Patent Revision Endorsed in House

By Ford Eastman

Washington—Modification of the National Aeronautics and Space Administration's patent regulations to make it easier for industry to retain title to inventions made while working on government contracts was urged last week by the House Subcommittee on Patents and Scientific Inventions.

In a report to the full Committee on Science and Astronautics, Rep. Erwin Mitchell (D.-Ga.), subcommittee chairman, said the patent provisions of the 1958 Space Act should be amended along the lines suggested earlier by NASA (AW Dec. 14, p. 57) and should be acted upon immediately. Mitchell said the current provisions "tend to complicate and retard the conduct of the American space program."

At the same time, top NASA officials appeared before the full committee headed by Rep. Overton Brooks (D.-La.) to support other changes in the Space Act recommended by President Eisenhower in a message to Congress in early January (AW Jan. 18, p. 35). Recommended changes are:

• **Abolition of the** National Aeronautics and Space Council, which was created to act as an advisory group to the President on all space matters. It is composed of the President as chairman, the Secretary of State, Secretary of Defense, NASA administrator, Atomic Energy Commission chairman, one additional member from within the federal government and three persons from outside the government.

• **Repeal of the specific** statutory enumeration of the President's duties, such as developing a comprehensive space program and the fixing responsibilities of aeronautical and space activities, and transfer of these responsibilities to NASA subject to the authority and direction of the President.

• **Abolition of the Civilian-Military** Liaison Committee which was created as a channel of communication between NASA and the military services and to resolve problems that might arise over jurisdiction of certain aspects of the space program.

• **Add a provision that would** give the President authority to assign responsibility for development of new launch vehicles, regardless of which agency has the prime requirement for their use in space missions.

The patent subcommittee recommendations followed extensive hearings last fall and early this year in which almost blanket dissatisfaction with the NASA provisions was expressed by government witnesses as well as by those representing private industry.

Most of the objections were directed toward the requirement that the government take title to all inventions or discoveries made in connection with space work unless government rights

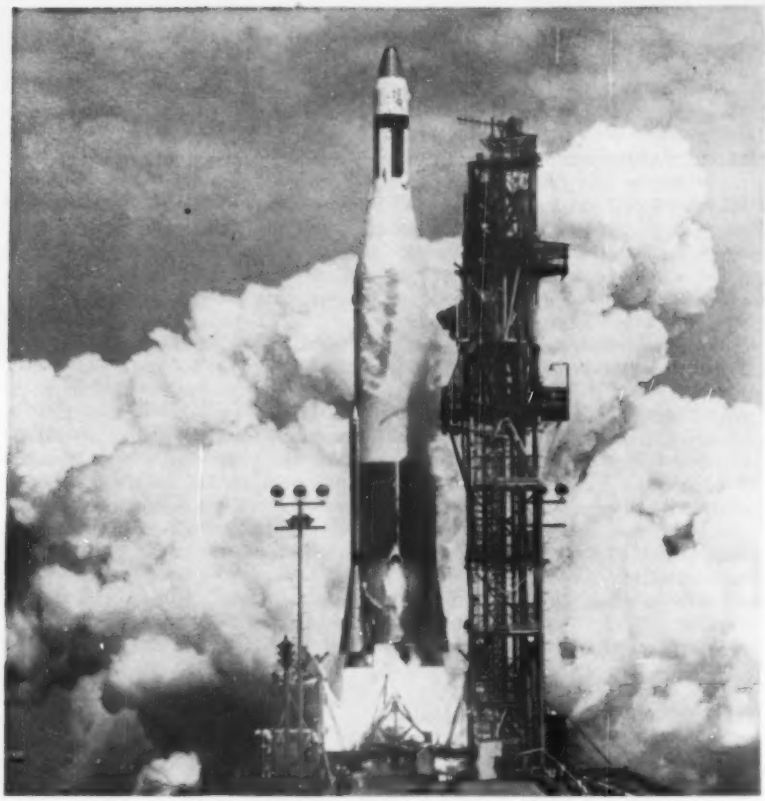
Atlas, Titan, Polaris Tests

Cape Canaveral, Fla.—Air Force-Convair Atlas intercontinental ballistic missile last week made its initial flight carrying the Arma all-inertial guidance system that will be used in later squadrons of operational Atlases.

Arma system did not control the missile but sent its signals instead to monitoring instrumentation that indicated what its performance would have been if it had been in control. Missile's 5,000-mi. flight was controlled by the General Electric-Burroughs radio-inertial guidance system used in all previous test flights.

Attempt to obtain second stage ignition for the third time in the USAF-Martin Titan failed last week, apparently because a gas generator valve in the second stage failed to open. First stage operated satisfactorily. Burnout of the first stage, activation of the gas generator and spin-up of the turbine in the second stage were achieved. Separation occurred, and the signal sent to the valve telling it to open apparently was received, but the valve failed to open.

In another launch last week, Navy-Lockheed Polaris A1X-14 was launched in a successful 900-mi. test. Polaris test vehicle was first of a new bloc of 13 flights in the A1X series, and its flight control system was extensively modified to make it lighter and easier to maintain under operational conditions.



Midas Launch Attempt Fails

Midas infrared early warning satellite was launched at Cape Canaveral, Fla., by Convair Atlas 29-D topped by Lockheed Agena (AW Feb. 29, p. 31) but the attempt failed when the Agena stage apparently exploded at point of separation from its Atlas booster. Telemetry indicated Agena stage was in proper position at Atlas burnout to be put into a low, non-polar orbit; indications are an explosion caved in top of the Atlas propellant tank adjacent to Agena stage. Second Midas and attached Agena stage have been delivered and second launch is scheduled for late March.

are waived under certain conditions.

In the subcommittee report, the wording of a more liberalization of rules recommended by NASA was accepted but with "certain safeguards added to make doubly certain that the proper interests of the government and the public are protected." "Safeguards" are:

• "**That the NASA administrator** in all research and development contracts, obtain for government use not less than a royalty-free, irrevocable license on any inventions produced thereunder.

• "**That the public interest** will have been adequately protected by the acquisition of a royalty-free, irrevocable license unless the administrator determines that he must acquire a greater right in the invention because of other federal statutes, or, that the national security or general welfare demands a greater government right." This provision was added, the subcommittee said, to simplify the NASA administrator's duties and to expedite the administration of space research contracts.

At the same time, the subcommittee submitted a statement of congressional intent with regards to the provisions and asked that it be approved by the full committee and made a part of the legislative history.

The subcommittee said that, in recommending revision of the patent provisions, it intended to provide NASA with further means for bringing about necessary advances and innovations in its fields of technology in the shortest possible time and at the lowest possible cost.

"Recognizing that continuation of the free enterprise system is dependent upon maintenance of adequate incentives to compete in business," the statement said, "and recognizing further that the greatest incentive in private ownership of inventions and patents thereon lies in the prospect of commercial utilization of the inventions, the committee urges the administrator of NASA to take from private ownership only so much of the property right in inventions and patents thereon as may be necessary to fulfill the requirements of government and protect the public interest."

In setting guidelines to help determine disposition of invention rights, the subcommittee said NASA should consider any of the following elements that may exist as being circumstances normally favoring retention of title by the contractor:

• "**Where the technological field** being explored under the contract is so related to fields of commercial endeavor that the inventions likely to result would have substantial promise of commercial utility and their early development would be apt to benefit the national economy.

• "**Where insistence upon more than** an irrevocable, nonexclusive, nontransferable, royalty-free license for governmental use would preclude or seriously impair contracts for the desired research and development work and alternative sources for the contract are not readily available.

• "**Where inventions likely** to be involved under the contract have been conceived and constructively reduced to practice by the contractor prior to the contract.

• "**Where the contractor has extensive** competence and experience in the field of technology which is to be explored under the contract and inventions likely to result would be attributable to such competence and experience."

Acquire Title

The subcommittee said any of the following elements that may exist would be circumstances normally favoring the right to acquire title by the government:

• "**Where the contract calls** for exploration into fields which directly concern the public health, safety or welfare, and the inventions likely to result would be useful directly in such fields, and the public interest would be best served by making such inventions available for all to produce or use without payment of royalties.

• "**Where it is likely** that any inventions actually reduced to practice under the contract will have depended in substantial degree upon the prior or parallel conceptions and work of other parties, governmental or private.

• "**Where the government has been** at the time of contracting the sole or prime developer of the field of technology involved or has provided all or virtually all of the funds required for the operations and activities of the contractor in such field.

• "**Where the field of technology** involved in the contract is entirely new without significant commercial or private history and with little chance of non-governmental development in the foreseeable future."

NASA General Counsel John A. Johnson told the full committee that NASA would accept and support the subcommittee recommendations and that he does not believe the added "safeguards" would impose a serious hardship.

IATA to Boost Fares For North Atlantic Jets

Paris—International Air Transport Assn. emergency meeting was nearing an end late last week with higher air fares on jet North Atlantic flights a major result of the three-week-long session.

IATA officials, with the conference still in session, refused to comment on details of North Atlantic rates. Participating member airlines were all under the usual IATA ban against leaking information. However, it was no secret that one of the main results of the Paris session will be higher basic fares on jet flights over North Atlantic, as reported in the Mar. 7 issue of AVIATION WEEK (p. 333).

Preconference predictions had all pointed in the opposite direction.

Conference closing was being delayed by questions other than the North Atlantic. New fares in this region have been decided upon, both for jets and for piston aircraft.

North Atlantic fare pattern come May 1 will look something like this:

- **Only two fares** will be offered on jet flights, first class and economy.
- **First-class fare** one way between New York and London would be roughly $500 in place of the present first-class fare of $440. Some observers, however, indicate the new jet first-class fare will be somewhat higher than $500.
- **Economy jet fare** one way between New York and London also will increase. Some observers say the new fare will be $272, in place of the present economy fare of $257. If this is true, then North Atlantic carriers are really adding the current $15 jet surcharge to the basic fare. Here again, however, some IATA observers say the new jet economy fare will be slightly higher than $272.

The IATA session apparently decided to create a separate fare structure on the North Atlantic for piston aircraft. First-class piston fare will be some $40-to-$50 cheaper than first-class jet. First-class piston with sleeperette will about equal normal first-class on jet. No figures were available on piston economy fares, although a similar differential with economy jets would be the case here as well.

It also was understood that an agreed upon excursion fare would apply under set conditions, reportedly at $320 round trip New York-London. Actually, this excursion fare also is slightly higher than known proposals. TWA, for example, proposed a North Atlantic excursion fare of $312 last fall. TWA proposal would have applied on jets.

While the move toward higher fares seems to have carried the day on the North Atlantic, elsewhere the trend was definitely toward lower fares. British Overseas Airways Corp.'s desire to knock fares down on Middle Eastern and African routes apparently was fairly successful.

GE Nuclear Shuffle

Washington—General Electric Co. has ordered a major reshuffle of its nuclear energy activities, including dissolution of its Atomic Products Division.

Aircraft Nuclear Propulsion Department, formerly under the Atomic Products Division, is operating temporarily without a divisional structure in a reshuffle of its own management and a shift of emphasis to a more advanced nuclear powerplant. Until the ANP Department is assigned to a new division, it will report directly to group Vice President Cramer W. LaPierre.

The two other departments formerly under the Atomic Products Division—the Hanford Atomic Products Operation in Washington State and the Atomic Equipment Power Department—are both primarily concerned with commercial nuclear applications and have been formed into a new unit known as the Electric Utility Group.

In line with a Defense Department decision last summer not to try and put a nuclear aircraft into the air as soon as possible but to wait for development of an operational weapon system, the ANP Department is now placing increased emphasis upon improved materials and fuel elements.

Present acting manager of the department is S. J. Levine, who had been in charge of the group's Idaho Falls, Idaho, test facility. D. Roy Shoults, former head of the department, has moved to the GE corporate structure in New York as manager of atomic business development. Shoults' direct superior is Francis K. McKune, corporate vice president for engineering services. McKune also was formerly in charge of the Atomic Products Division.

News Digest

United Air Lines reported net 1959 earnings of $10,235,773 plus $3,562,848 gained on sale of surplus fleet aircraft compared with 1958 net earnings of $13,751,802 plus $548,460 realized from aircraft sales. Per share earnings for 1959 were $3.66 on 3,946,070 common shares outstanding compared with $4.05 in 1958, based on 3,687,772 shares.

Solar Aircraft Co. was acquired last week by International Harvester Co. through an exchange of one share of Harvester common stock for each 2¼ shares of Solar. Solar will be operated as a subsidiary, retaining its name, officers, product line and operating structure.

Polaris fleet ballistic missile with partially loaded first stage is scheduled for underwater launch this month from an area near San Clemente Island, Calif., to check operational ignition characteristics. The missile will travel about 15 mi. over the Pt. Mugu sea test range.

Sikorsky Aircraft Division of United Aircraft Corp. will produce HSS-2s, spares and related items for Navy under a $45 million contract. Deliveries of the twin-turbine anti-submarine warfare helicopters will be made between next December and December, 1961.

Bell Aircraft Corp. net income for the year ended Dec. 31 was $3,388,192 or $1.26 a share on total sales of $128,074,710 compared with net earnings of $4,758,700 or $1.77 a share on sales of $182,887,229 for the year 1958.

Grumman Aircraft Engineering Corp. will build 42 AO-1AF Mohawk observation aircraft for Army under a $21 million follow-on Navy contract, with deliveries beginning next year. Grumman earlier received a contract to build 35 AO-1s (AW July 27, p. 59).

Republic Aviation Corp.'s 1959 earnings were $3,386,000 on sales of $197,760,000, drop of $1,734,901 under the previous year's earnings. Sales in 1958 totaled $218,547,879. Company backlog is $511 million.

Soviet Union is completing final negotiations for the purchase of two Sikorsky S-58 and two Vertol Model 44 helicopters at a total cost of approximately $2 million, according to Vladimir Alkhimov, commercial counselor at the Russian Embassy. Embassy officials also have shown some interest in the three-place Hiller UH 12E.

Maj. Gen. William Canterbury, now deputy chief of staff of Air Research and Development Command for research and engineering, will switch to commander of the ARDC's Research Division replacing Brig. Gen. Benjamin Holzman who will remain as vice commander.

Failure of the left wing at the inboard third of the No. 2 tank in upward bending and nose-up torsion microseconds before fire started was indicated during Civil Aeronautics Board structural investigation hearing last week on crash of Braniff Airways Lockheed Electra near Buffalo, Tex., Sept. 29 (AW Oct. 26, p. 45).

Boeing Airplane Co. has filed a patent application on a nuclear turbojet designed to propel submarine and surface vehicles at more than 100 mph.

Carriers Dispute Board's Coach Stand

Freedom of the airlines to establish service patterns without interference appears headed for showdown.

By L. L. Doty

Washington—Thorny issue of how much freedom airline managements should be allowed in establishing coach service without Civil Aeronautics Board interference now appears headed for a showdown.

For several years, trunklines have grappled with the touchy question of how far coach traffic can be expanded as a means of opening new markets without seriously shaving revenues. Now, the Board apparently is prepared to give them that answer and direct them to establish coach service in whatever markets it feels such service is warranted.

Most airlines believe that the question has no concrete answer that is applicable to all markets under all operating conditions.

The Board, on the other hand, is taking the position that service standards can and should be set as the only guide toward determining whether adequacy of service is being provided in all markets.

These opposite views form the key to the current CAB New York Coach Investigation—a case that is being participated in reluctantly by many trunklines on grounds that the issues involved should be resolved through direct consultation or by inviting comments from the airlines rather than through public hearings which have been recessed until Apr. 4.

Meanwhile, another test case on virtually the same issues is under way. Last November, Capital Airlines—found by the Board to be providing an inadequacy of service in the Toledo market—was directed to add coach service to its Toledo schedules. The airline has appealed this decision in the Federal Court of Appeals.

Agreeing that the Board has the right to correct inadequacies of the whole of a service by calling for schedule increases, Capital has challenged the Board's legal right to specify coach service in the adjustment. The airline claims that the Board should consider all services rendered in determining inadequacies, that Toledo was receiving sufficient coach service from other carriers and that Capital would incur severe losses by adding coach service to that already available.

On the latter point, the Board, in effect, countered that losses incurred from such services constitute the price a carrier must pay in fulfilling the obligations of its certificate. Coincidentally, it is from this point that most philosophies emerging in the coach investigation case stem.

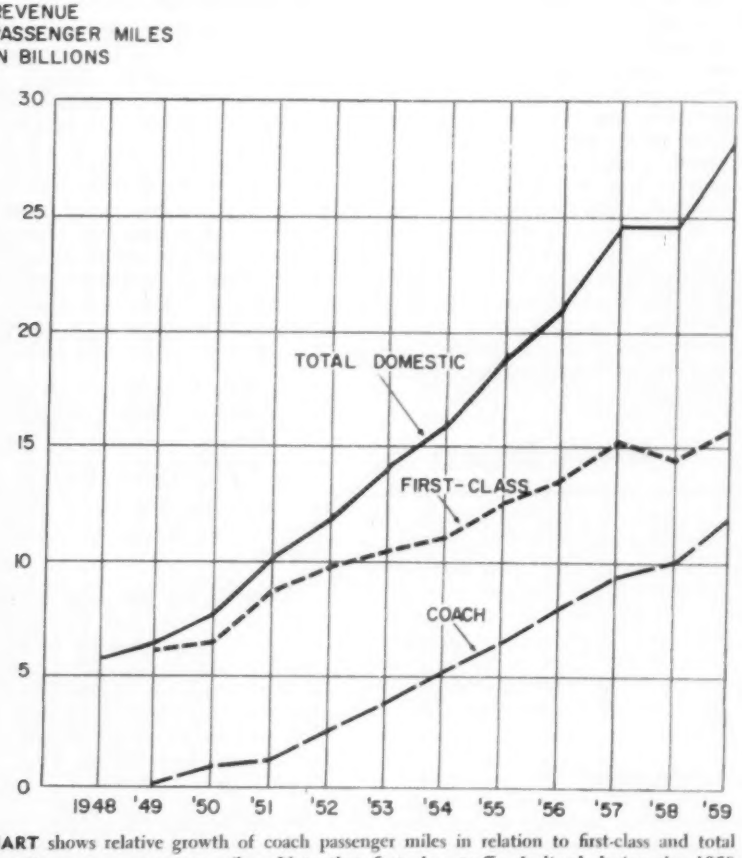


CHART shows relative growth of coach passenger miles in relation to first-class and total domestic revenue passenger miles. Note that first class traffic declined during the 1958 recession, while coach traffic continued to climb.

Trunkline Position

Generally, the majority of trunklines agreed that coach service in short-haul markets is unprofitable and will not attract new traffic because of the slight differential in fares between coach and first-class rates. In addition, it was agreed that coach is more readily adaptable to tourist or vacation-type markets than to business-travel markets.

On this point, Braniff Airways testified that the "majority of the coach passengers we do carry (in the Dallas-Chicago market) are overflow from first-class and take coach because they can't get anything else. . ." Braniff, which predominantly serves commercial markets, said that until recently coach available seat miles amounted to about 15% of the total offered but added that this volume is increasing as more Boeing 707 turbojets with combined seating configurations are introduced.

Northeast said that it concentrated on first-class service in the Boston-New York-Washington market because the business traveler using the service valued flight frequency and service above other factors and that the cost has "little

basis for his decision." On the other hand, Northeast said about 90% of its available seat miles in the Florida vacation market is coach.

Eastern stated that short-haul coach service must be a part of a long-haul operation if it is to be operated at a break-even level. The carrier admitted that coach service will generate new traffic but added that day coach "definitely diverts traffic from first-class service."

TWA reported that it has emphasized coach in the past for competitive purposes but added that it "went to both ends of the scale" with its four-engine, piston-powered aircraft by matching its extensive coach service with the large "siesta" seats in first-class service. TWA charged that, on a fully allocated cost basis, coach service conducted in short-haul markets will operate at a loss.

United estimates that it loses $2 million annually on intra-state traffic in California and added that the bulk of that traffic is coach business in the Los Angeles-San Francisco market. The airline, which continues to oppose high-density seating in coach configuration, said the fare level in the San Francisco-Los Angeles market is too low and noted that the first-class yield amounts to 7 cents per mile as compared with 4.4 cents for coach.

When coach service on the route began in 1949, rates were set at 3 cents per mile as compared with a 4 cent industry average, 4.5 cents for transcontinental routes. The carrier said the current low coach rate merely creates a loss operation and does not stimulate any substantial amount of new traffic since the growth rate in the market has been no greater than that in other markets.

Delta strongly supported coach service, noting that all its aircraft, including the DC-7s and DC-8s, will offer coach accommodations on the theory that the carrier is thus "able to appeal to a broader market and acquire more traffic and revenues" than it otherwise would.

Over-Capacity Potential

During the hearings, Board Examiner Paul N. Pfeiffer attempted to draw reaction from witnesses on the problem of over-capacity which could result from the increasing introduction of jet equipment (AW Dec. 28, p. 26). General response appeared to be that fare reductions will not produce enough traffic to fill any large increase of available seat miles should it occur.

Nevertheless, a number of airline officials have previously expressed concern to AVIATION WEEK over the prospects of fare cuts in moves to offset load factor declines.

On this point, United Air Lines President W. A. Patterson told AVIATION WEEK (AW Feb. 29, p. 43) that the Board should use "soundness and good judgment" in passing on low, competitive fares. American Airlines President C. R. Smith also has voiced a fear that an overdose of competitive fares could result in a deterioration of normal passenger traffic yields.

Many airline officials want to see the establishment of a sound fare structure before too many carriers commit themselves to wide-scale seasonal fare adjustments or to an unnecessary expansion of coach services. In the past, some promotional fares have been successful in generating higher revenues while others have depressed revenues.

For example, the reduced night coach fare on New York-Miami nonstop flights, effective Mondays through Thursdays, introduced by National during the summer of 1959, gave National, Eastern and Northeast an average load factor of 78% on the service.

This resulted in a net load factor increase on all night coach services. An economy day coach fare, introduced during the same period, had no such bolstering effects. Day coach system load averages for the three carriers combined dropped from a 1958 level of 45% to 44% in 1959.

Specifically, most carriers want freedom to experiment in the various markets to determine the need and profitability for setting reduced rates. Charles Beard, president of Braniff, has said: "We hear a lot about bringing fares down for the common man, but our experience has been that the common man prefers first-class meals and service. By the middle of 1961, we will know whether the common man can be persuaded to fly coach on our routes through lower fares."

One final question many industry leaders are now asking with respect to coach fares: Is coach yield per passenger sufficiently high to prevent a financial breakdown within the industry in the event the general economy fails to respond to the optimistic forecasts made for 1960 by a number of top economists?

USAF Plans Expansion of Logair Airlift

By David H. Hoffman

New York—Major expansion of Air Force's Logair operation now under way will force commercial carriers winning large Fiscal 1961 contracts to re-equip their fleets with aircraft capable of hauling "outsized cargo."

Carriers competing for a series of contracts representing about 25% of all Logair scheduled mileage are bargaining with Lockheed Aircraft Corp. for C-130B turboprop transports—the only plane in production capable of meeting all of the performance and design specifications designated by Air Materiel Command.

Other carriers have approached Armstrong Whitworth Aircraft, Ltd., in Great Britain, manufacturer of the AW 650 Argosy four-turboprop freighter, in an effort to obtain an aircraft that would fulfill Air Force requirements on three of the four route patterns encompassed by the 9,232,310 stat. mi. proposal made by Logair last month.

With either of the two aircraft operating daily along its routes, Logair could cut pipeline times on bulky jet engines now traveling to and from Strategic Air Command bases, maintenance depots and aerial ports within the Zone of the Interior by railroad and truck. This would reduce inventory and warehousing requirements and result in a cost saving of up to $1 million per day, AMC officers report. All bids must be filed at Scott AFB, Ill., by 4 p.m. on Mar. 18.

Specified Routes

Under the Logair system, contracts will be awarded to the carrier or group of carriers that can fly specified routes at minimum plane-mile cost to the Air Force. Bidding, therefore, resolves itself into a two-way contest pitting the C-130B Hercules against the Argosy, with each carrier seeking to demonstrate that it can operate one or both of the transports more economically than can its competitors.

Present mileage flown by Logair carriers will not be increased under the Request for Proposals (RFP) to transport outsized cargo during the fiscal year beginning July 1, 1960. But because an aircraft must be furnished with a cargo-carrying capacity two to four times greater than that of the Curtiss C-46s and Douglas C-54s now in the Logair fleet, the contracts to be awarded represent a major expansion of the Logair airlift.

Officials at the Lockheed plant in Marietta, Ga.—which manufactures C-130 series transports for the Air Force—told AVIATION WEEK that in the past month more than 20 commercial carriers have expressed an interest in the Hercules aircraft as a result of the RFP. But the company, as yet, has not received inquiries from "major trunkline operators," they said.

Estimating that 13 C-130Bs would

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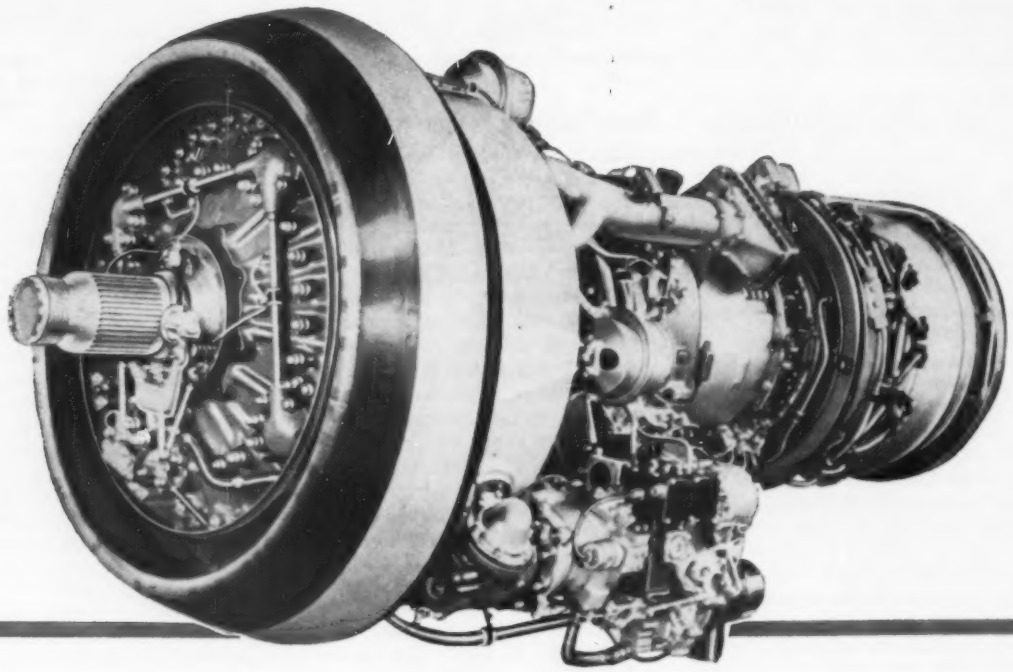

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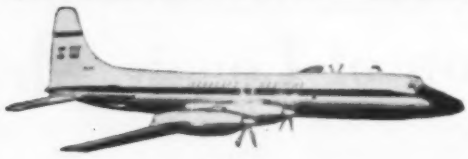

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be needed to fly Logair outsize cargo routes, Lockheed has informed interested carriers that it could deliver the first Hercules of a purchase order during May, 1961, without special arrangement with the Federal Aviation Agency or the Air Force. Fly-away price would be "a little over $2.5 million," according to the company.

Last week, however, a team of Lockheed officials planned to meet with representatives of the FAA to discuss expediting the plane's certification program, which normally would consume between six and eight months. A provisional certification program that would authorize the plane's operation only on the Logair mission may emerge from this meeting.

A second means of advancing the delivery date—diversion to a commercial carrier of C-130Bs being assembled for the Air Force—is being explored by Lockheed. A bailment agreement with the Air Force under which civilian air crews would fly government-owned C-130Bs while the contract carrier awaited delivery, is a third alternative under consideration in Marietta.

Lockheed's decision to certificate the C-130 for the commercial market was reached only after the Logair RFP, distributed to 96 carriers, had stimulated a new demand for the aircraft. Company's original intention was to manufacture C-130s only for the military, while focusing commercial sales efforts on the GL-207 Super Hercules, a 250,000 lb. gross weight freighter version of the C-130.

A second factor leading Lockheed to reappraise the sales potential of the C-130 was the frequency of inquiries made by independent operators and companies not involved in air transport, most of which wanted to haul a particular piece of outsize hardware in the Hercules. To Lockheed this indicated that the plane, with its direct-loading aft cargo doors, could capture a portion of the charter and leasing business for a purchasing carrier.

Carriers negotiating with Armstrong Whitworth may be able to acquire Argosies before Lockheed can deliver C-130s, if they place firm orders promptly. Six of the transports now are flying in the company's certification program, with actual certification expected this month. A seventh Argosy is being readied for flight, and three more are in an advanced building stage, according to Armstrong Whitworth.

After this initial production run of 10 aircraft has been sold, the company estimates that deliveries cannot recommence for about 15 months. Holding several letters of intent from interested carriers—three of which, the British manufacturer reports, are likely to be converted into firm sales within the next two weeks—Armstrong Whitworth may not have Argosies available when Air Force awards the outsize cargo contracts.

Argosy's maximum gross weight is 88,000 lb. Aircraft can carry a payload of 28,000 lb., but this decreases to 27,000 lb. for 600 stat. mi. stage lengths and to 24,400 lb. for 750 stat. mi. stage lengths. On a 1,200 mi. flight, the longest required by the Logair RFP, Argosy's payload would be about 20,500 lb. The C-130B, by comparison, may take off at 135,000 lb. It can carry full payload of 39,000 lb. on stage lengths of up to 2,185 stat. mi., according to Lockheed, at a direct operating cost to the carrier of about 5.65 cents per ton mile.

Specifications, jointly prepared by Military Air Transport Service and AMC, require that the Logair freighters have "nose or tail loading characteristics" and a truck bed loading height of 40 to 54 in. In addition, transports flying on one of the four route patterns involved must have a minimum available cabin load (ACL) of 25,000 lb. and a cargo loading door at least 96 in. x 96 in. in area. On route patterns one through three, the aircraft must have an ACL of 15,000 lb. and a cargo loading door at least 76 in. high and 96 in. wide.

On one or more counts, the Douglas DC-7F, Lockheed 1049H, Canadair CL-44 and all cargo aircraft now in use or on order are ruled out, excepting the C-130 and the Argosy on patterns one, two and three. Despite this, the Logair RFP requires that the transport selected by the carriers be put into service no later than Mar. 31, 1961.

Specifying an aircraft unavailable on the commercial market and not, at the time, contemplated for it, the RFP provoked a dual reaction from airline officials. One group maintained that the Air Force deliberately had given the carriers an impossible task to perform in order to silence complaints that MATS and other Air Force aircraft were carrying routine commercial cargo on domestic routes.

Carrier spokesmen adhering to this belief pointed out that while the outsize cargo contracts seemingly could be renegotiated for second and third year periods, the RFP hinged this privilege upon the availability of Logair appropriations and the continuation of Logair requirements. This meant that the carriers were being forced to procure costly new aircraft for what could prove to be a one-year operation, they said.

Siding with the Air Force, a majority of the carriers' cargo experts queried by AVIATION WEEK offered these key points in rebuttal:

Commercial carriers for years have been asking the Air Force for "a job to do" in transporting more military cargo within continental United States. Outsize cargo contracts, which carry with them all freight along specified route patterns, represent such a job.

The Air Force has "made a market" for the freighter and thus eased the problems involved in financing the purchase. At the carriers' request, it also has extended the phase-in time for the transport, giving bidders a year in which to acquire aircraft.

Logair Operations During 1959

	Aircraft Stat. Mi.	Ton Miles
AAXICO	11,126,464	55,002,273
Capitol Airways, Inc.	7,040,019	34,522,534
Resort Airlines, Inc.	6,195,025	40,759,488
*Riddle Airlines, Inc.	2,855,381	13,771,096
*Slick Airways, Inc.	2,673,830	19,019,587
Totals	29,890,719	163,074,978

	Ton-Mile Costs to Air Force by Carrier During Calendar 1959
**AAXICO	$.140
**Capitol	.129
**Resort	.138
Riddle	.150
**Slick	.139

	Plane-Mile Rate Paid to Carrier by Air Force During Fiscal 1959
AAXICO, C-46 feeder service	$ .6995
Capitol, C-46 transcontinental service	.6720
Riddle, C-46 feeder service	.7364
Resort, C-54 transcontinental service	1.0861

Total Logair Fleet: 50 C-46s and 19 C-54s.

*Slick assumed Riddle's obligations on June 30, 1959, when Riddle discontinued Logair service.

**Costs unadjusted for petroleum and maintenance rebates.

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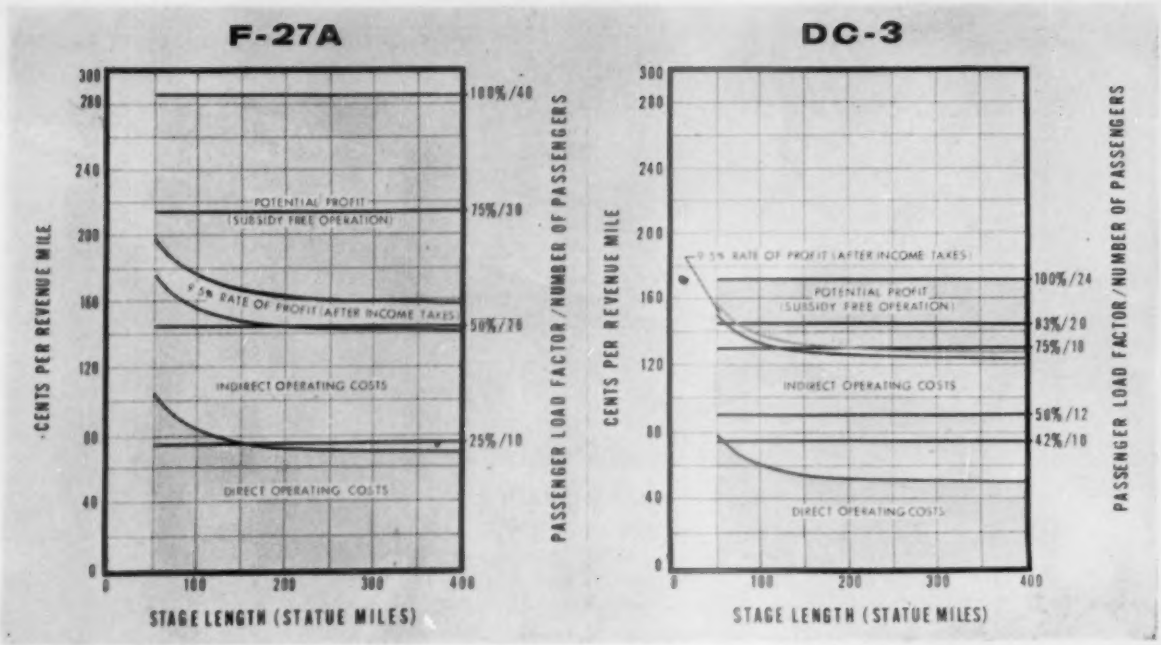

CHARTS detail cost comparisons and rates of profits for operations involving Fairchild F-27 turboprop and Douglas DC-3.

Experience Cuts F-27 Operating Costs

Washington—Value of increased operational experience as a means of realizing extensive cost reductions in F-27 turboprop operations was highlighted in an analysis of four local-service airline operations made by the Fairchild Engine & Airplane Corp.

In a detailed report of experience with the F-27 by West Coast, Pacific, Piedmont and Bonanza airlines, Fairchild reported significant decreases in F-27 operating costs plus over-all system traffic gains directly related to introduction of the turboprop transports.

Comparing results of the first full quarter of F-27 operations for each carrier with the third quarter of last year, Fairchild said the airlines' average direct operating costs for the aircraft fell from 97 cents per revenue plane mile to around 89 cents based upon third quarter F-27 stage lengths of 101 mi. for West Coast, 90 mi. for Piedmont, 164 mi. for Bonanza and 98 mi. for Pacific.

While the carriers' actual direct operating costs for the third quarter averaged almost seven cents per revenue mile higher than that estimated for the period, Fairchild said over-all cost and revenue performance since first being introduced indicates the aircraft will continue to offer users lower operational costs plus greater traffic generation.

Beyond the direct cost savings, the manufacturer said average F-27 earnings which can be applied toward indirect costs and profits increased from approximately 31 cents per revenue mile in the first full quarter of operations to 43 cents in the third quarter of 1959. Indirect operating costs for the aircraft also decreased to 73 cents per revenue plane mile in the third quarter as compared with an average of 77 cents for the first full quarter of operation by the four airlines.

Economic Potential

Citing the greater economic potential of the F-27 as compared with the Douglas DC-3 for an eventual subsidy-free operation, Fairchild said its figures indicate that, at a 75% load factor of 30 passengers, F-27 can produce substantial subsidy-free profits at any stage distance, whereas the DC-3 requires subsidy at stage lengths of 200 mi. or less. At a 50% load factor, F-27 revenues cover nearly all indirect costs at stage lengths less than 200 mi., and all of this expense on longer stage lengths, Fairchild said. In comparison, Fairchild said the DC-3 with the same load factor applied to a 200-mi. stage length can not earn revenues sufficient to cover its indirect costs.

Expressed in terms of annual profit potential between the two types of aircraft, the F-27 over 100-mi. stage lengths has a maximum pre-tax profit potential of about $770,000 annually as compared with $130,000 for the DC-3, Fairchild said.

With the operating experience of the four local-service carriers as a guideline, Fairchild's analysis indicates that subsidy-free profits can be earned with the F-27 if load factors of above 60% can be attained and if average stage distances are lengthened.

Pronounced traffic increases which followed the introduction of F-27 service were cited by the report as clear indication that the turboprop's passenger appeal and additional seating capacity have been responsible for heavy traffic gains by the airlines.

In May, 1959, F-27 passenger traffic densities ranged from 5.78 to 9.35 passengers per mile above comparable 1958 DC-3 densities for gains of from 49% to 99% above prior DC-3 densities. By August, F-27s carried 42% to 60% more passengers than DC-3s carried in the same month of the previous year, according to Fairchild.

As an example of the F-27's traffic generating capability, Fairchild points to a comparison study of Aloha and Hawaiian airlines covering a period from July, 1951, to May, 1959, when Aloha inaugurated F-27 service. Through the almost eight-year period, Aloha usually carried an average of 30% of the scheduled inter-island traffic and Hawaiian 70%. Prior to 1953, both carriers operated only DC-3 equipment. Hawaiian placed Convair 340s into service during the first quarter of that year.

While introduction of the Convairs appeared to have little impact upon the traffic of Hawaiian, Fairchild said, the introduction of Aloha's F-27 service

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boosted the carrier's share of inter-island traffic to 45% within three months. Aloha presently operates three F-27s, while Hawaiian operates seven Convairs. Both carriers have about the same numbers of DC-3s in service.

Fairchild added that, while it is unable to arrive at any precise formula to measure the extent of traffic generation directly attributable to the F-27, its test studies covering the four local service operators and the Hawaiian carriers "suggest most strongly" that the turboprop's use has fostered traffic gains.

Operations Review

Reviewing the experiences of the four airlines since they began F-27 operations, Fairchild said that in each instance the airlines' increases in traffic densities closely followed the introduction of turboprop aircraft. While the F-27's present contributions to indirect costs vary with each carrier, Fairchild said they still exceed the past and present figures of the DC-3 and are being made on the strength of relatively short operational experience.

West Coast, which began F-27 service in September, 1958, and now operates six of the turboprops, increased stage lengths from 80 to 100 mi. on the aircraft and averaged 18 passengers per revenue plane mile in September, reflecting a decrease in traffic density because of the longer stage lengths. F-27 direct operating expenses during this period fluctuated considerably because of the timing of its accounting procedures, the Fairchild study indicated, and ranged from a beginning cost of about $1.05 per revenue plane mile to only 92 cents. At the same time, the aircraft produced passenger revenues of $1.12 per plane mile by the end of the third quarter of last year as compared with direct expenses and revenues of about 64 cents a plane mile for the DC-3 at the end of September.

Winter Conditions

Piedmont, with eight F-27s in a 36-seat configuration, began its turboprop service in November, 1958, over stage lengths of approximately 90 mi. Introduction of the new service under winter conditions caused a drop in average number of passengers carried per revenue mile from almost 20 to less than 15, but the figure had climbed back to 19 by the fall of last year, the report said. The airline began F-27 operations with passenger revenues of about $1.35 per plane mile, which dropped to $1.05 during the last winter season but returned to above the $1.30 mark by last September. Direct expenses for the aircraft during this period also fluctuated but were at the $1.03 per plane mile level by the end of last year's third quarter. DC-3 direct operating expenses at the end of the quarter were placed at 63 cents and passenger revenues at about 77 cents.

Bonanza, with three F-27s in operation since last March, has experienced passenger loads of from 19 to 23 passengers over average stage lengths of 165 mi., according to Fairchild, with a decrease in system load factors during the summer off-peak travel season.

Expenses Drop

During this period, F-27 passenger revenues decreased from $1.51 per plane mile to about $1.28 in September, while direct operating expenses on the aircraft dropped from a high of 95 cents to a low of 75 cents per revenue mile. DC-3 passenger revenues dropped from 85 cents a mile to 53 cents a plane mile in the same period, while direct costs for the aircraft climbed from 50 cents to about 63 cents, Fairchild said.

Pacific, which operates six F-27s with a 44-seat configuration, carried an average of 18 passengers per plane mile when turboprop service began last April. This figure had climbed to 22 by the end of the third quarter as compared with 20 for the carrier's Martin 2-0-2 average passenger density and 10 on the DC-3s.

Plane mile passenger revenue for the turboprop during this period increased from a beginning $1.10 to around $1.38, while initial direct operating costs increased from 60 cents to around 82 cents on a plane mile basis, according to Fairchild.

The airline's Martin 2-0-2 aircraft which also carry 44 passengers, earned passenger revenues of around $1.29 per plane mile by the end of September, 1959, and experienced direct cost expenses of 90 cents.

Varig's First Boeing 707-420 Rolls Out

First Boeing 707-420 Intercontinental jet transport for Varig Airlines of Brazil is rolled out. Varig has one other 707-420 on order. The transport, powered by four Rolls-Royce Conway turbojets, can carry 189 passengers. Maximum cruise speed is 605 mph.

Texas Airline Starts Commuter Service

Dallas, Tex.—Low-cost commuter-style scheduled intrastate airline operation in direct competition with rail, bus, and auto travel between Dallas and Houston was inaugurated here last week by the recently-formed Lone Star Airlines.

With a basic fare of $10.80 plus tax, the new carrier initially is operating 12 daily round trips during weekdays and 10 round trips Saturdays and Sundays, using three former Trans World Airlines Martin 2-0-2As fitted with 44 passenger seats in place of the normal 36.

Conventional single-ticket procedures will be followed, but Lone Star also is offering 10-trip commuter books, good for use within 120 days at $102.66 plus tax. Freight service also will be handled. Rates will include a $2.50 minimum on a five cents per pound basis, with 100-lb. shipments being carried at $4 per hundred, approximately seven cents lower than rate of other scheduled carriers, Lone Star officials contend.

The Martin 2-0-2As are leased from California Aero Corp., Burbank, which has been handling the surplus TWA equipment. Leasing agreement includes an option to buy.

David M. Segal, owner of the new airline, operates radio stations in Denver and San Francisco, making his headquarters at the former city. Lone Star staffing includes Stewart Faulkner, formerly of American, Continental, TWA and Capital airlines, as general manager; Dan Bush, formerly of United Air Lines, as chief pilot, and Al Hopkins, United Air Lines and Federal Aviation Agency, as maintenance chief.

SOVIET Tu-114 turboprop is on jacks in this final assembly station; note tail sections of two more aircraft in background.

Soviet Writer Scores Aeroflot Services

(Assigned to report on a "difficult" Aeroflot route, Izvestia special correspondent I. Drozdov flew from Moscow to Tashkent. His article, reprinted below, is sharply critical of terminal facilities and is entitled "The Earthly Disappointments of an Air Traveler." The report was translated by Prof. Secor D. Browne, vice director of libraries, Massachusetts Institute of Technology.)

The metallic voice of an announcer now and again sounded off:

"The Tashkent-Moscow flight is delayed . . . The Tashkent-Leningrad flight is postponed until tomorrow . . ."

I sat at the window of the air terminal and admired the beautiful Tu-104 which has now been parked on the apron for three days. I watched as two old Uzbeks came to the window eying the airplane. I was reminded of the dialogue between two peasants in Gogol's *Dead Souls* when they caught sight of Chichikov's fancy carriage, and I imagined that the two Uzbeks standing at the window might be carrying on a similar conversation:

"What do you say? Is that a good airplane or not?"

"A good airplane, good!"

"And what do you think? Would it take many hours to fly to Moscow?"

"I think it would take very few hours for it to fly to Moscow."

"And would it have to wait many hours to get permission to take off?"

"Many hours, indeed, many hours!"

All this took place at the Tashkent airport, the terminal point of my air trip.

The editors of Izvestia had assigned me to learn about passenger services on the lines of Aeroflot. They suggested that for this purpose I pick out a "difficult" route—for example, Moscow to Tashkent with a stop at Krasnovodsk.

So, here you are an Aeroflot passenger. In the cabin of the speedy airliner Tu-104 you feel satisfaction, joy, and pride in the achievement of Soviet technology. The huge ship gathers speed so fast that it seems to be drawn by fantastic power.

We arrive at Krasnovodsk exactly on schedule. The grateful passengers warmly bid farewell to the crew.

We enter the waiting room of the Krasnovodsk air terminal in an excellent humor. But at once the happy expression on everyone's face is replaced by anxiety. One traveler must arrange for travel to a distant region, another has to validate his ticket for another flight. The passenger is now at the mercy of the ground services of Aeroflot. And, hereupon, he becomes convinced that these services function considerably worse than those performed by the air crews—particularly the ground services at local airports, that is, airports which are not on the principal air routes.

In the waiting room of the Krasnovodsk air terminal it is colder than outside. The doors are ajar and a cold, cold draft blows all over the place. There is disorder everywhere. The floors are dirty. A group of drunks burst into the waiting room and begin a fight. The passengers try to find a policeman to separate the brawlers but there is no policeman at the airport. "There was one stationed here but they took him away," said the porter, taking upon himself the job of ejecting the ruffians.

Local Plane

Planes operate fairly regularly from Krasnovodsk to Ashkhabad but after Ashkhabad you transfer to a local plane which makes stops at Mary, Chardzhou and Bukhara.

The Ashkhabad air terminal is as cold as the one at Krasnovodsk. Local residents, people used to a warm climate, bundle up in quilted robes but the zero temperature chills them to the bone.

After great delay you finally take off. It soon becomes warm in the cabin and the passengers, forgetting their misadventures, bury themselves in their newspapers. The quiet is broken by the stewardess:

"You will be happy to know that we will not land at Mary, but we will fly straight on."

"What," exclaims one of the passengers, "What about me?"

"And us!" Other people cry out at the back of the plane. "We must get to Mary."

The stewardess shakes her head.

"What a pity! It means we will have to land after all!"

At Bukhara the aircraft stops a kilometer and a half from the terminal. According to the schedule this is a 15 min. stop but we wait 40 min. for a single passenger. Finally this passenger shows up. With a heavy suitcase he has run a long way through the wet snow.

An-10 Service

Moscow—Aeroflot has inaugurated its first scheduled passenger service with 100-seat four-turboprop An-10A transports.

In western Russia, An-10As were placed on three routes: Kiev-Moscow, Kiev-Lvov and Moscow-Rostov. At about the same time, the craft began service between Khabarovsk and Magadan in eastern Siberia. First scheduled flights with 85-passenger versions of the An-10 began last July.

Aeroflot also has announced inauguration of daily, 100-passenger twin-jet Tu-104B service between Moscow and Simferopol in the Crimea. The Tu-104Bs cover the 745-mi. route nonstop in about 1 hr. 50 min. as compared with 4 hr. 15 min. for twin-engine, piston-powered Il-14s which have been making the run with one stop.

Entering the cabin and wiping his feet he says:

"It isn't easy to run with a bad heart."

Passenger Bus

Why don't they bring the passengers out in a bus and on time, without delaying the aircraft?

Observing these scenes one cannot help thinking: "And what about the timetable?" Why has it not become an inflexible law for the air transport workers? Even in the first-class airports, the planes take off either a half an hour early or a half an hour late. Not infrequently, the takeoff time depends on the whim of the crew.

Sometimes the captain himself decides whether to land at an intermediate airport or to fly past.

The schedule is the law both for the workers of Aeroflot and for the passengers.

To violate it means to undermine faith in dependability of transportation. Imagine what would happen if a train had left 10 min. before schedule.

Air transport is younger than rail transport. It might be for this reason that it does not have the many traditions which are the pride of the railroad workers.

But air transport grows not daily, but hourly!

Airport Disorder

The Soviet people welcome new technological achievements before which yield both time and distance. But they rightfully resent the disorder in the airports. Even at Vnukovo, the airport of our capital (Moscow), passenger service is still bad. Everyone who comes to Moscow by air is convinced of this. As soon as he puts foot on the ground, there begin major and minor difficulties. The aircraft stops some 600 meters from the terminal, which distance the passenger must traverse on foot.

Getting one's baggage is also no easy problem. For an hour or even two hours the passengers wander around the terminal looking for their things and standing in line. And when at last they get their baggage and proceed to the bus terminal, there, too, they may suffer not a few misadventures. It works out that a thousand kilometers is covered in an hour, but it takes two or three hours to get from the airport to the city.

Aeroflot employes must get into their heads that the nature of air transportation demands the highest level of passenger service.

Much of that which now hinders the air traveler can be easily eradicated by friendly and cooperative work of the great Aeroflot team.

Soviet Airport Work Pushed for Tu-114s

Moscow—Russia is keeping its airport construction program in high gear during the winter months in an effort to provide badly-needed additional facilities for proposed new turboprop services.

Improvements at the Khabarvsk and Vladivostok fields are being rushed in anticipation of the first trans-Siberian Tu-114 flights this spring. At Stalinabad, capital of the Tadzhik Soviet Socialist Republic, construction has started on one of the largest airport terminal buildings in Central Asia. Il-18s will begin regular flights between Stalinabad and Moscow during the second quarter of 1960.

Russia reported that two other airport terminals have been completed. They are at Krasnodar, north of the Caucasus Mountains, and at Petrozavodsk, northeast of Leningrad.

Nine Carriers Supplement MATS

Contracts totaling $6,501,919.24 for the transocean transport of cargo and passengers from the beginning of this month through June 30 have been awarded to nine commercial air carriers by Military Air Transport Service.

According to MATS, the bulk of the contracts are to meet increased airlift requirements resulting from the release of MATS Boeing C-97 aircraft to the Air National Guard and from Army's request to move more personnel to and from overseas stations by air.

The balance of the awards represent a substitution for MATS flights while the service is engaged in test exercise Big Slam/Puerto Pine during the contract period. On this exercise, 465 aircraft will transport 22,000 Army troops to Puerto Rico.

The nine carriers will transport about 29,200 military passengers, 2,700 tons of military cargo and 900 tons of mixed traffic (passengers plus cargo) in the Pacific and Atlantic theaters. Successful bidders were Twentieth Century Airlines, Inc., $1,935,742; the Flying Tiger Line, Inc., $1,081,958.82; Seaboard and Western Airlines, Inc., $958,835.50; Hawaiian Airlines, Ltd.; $857,955; Overseas National Airways, Inc., $564,292.50; Capitol Airways, Inc., $489,278.32; Los Angeles Air Service, Inc., $408,161.92; Slick Airways, Inc., $128,508, and Trans World Airlines, Inc., $77,187.18.

In addition, MATS awarded short-term call contracts worth $351,011.48 and covering airlift requirements for 3,400 military passengers in Alaskan and other Pacific areas during this month and April to five commercial carriers.

These awards were to Twentieth Century, Los Angeles Air Service, Overseas National, Alaska Airlines, Inc., and Capitol Airways. They bring the total value of MATS contracts awarded to commercial airlines thus far this fiscal year and through September, 1960, to more than $85.5 million.

Avro Starts Survey Of Turbofan Market

London—A. V. Roe is conducting a market survey for two short-haul turbofan-powered airlines. Both are twin engined projects, with rear engine configurations, designed to cruise around Mach 0.85 and carry a full payload with reserves 500 naut. mi.

Larger version seats 65 passengers and will be powered by the Rolls-Royce RB.165, a Conway-type turbofan engine with a fan ratio around 1:0. This variant version has not so far been mentioned by Rolls-Royce.

Alternative version seats 50 passengers and will be powered by the Bristol Siddeley turbofan BS.75 of 7,000 lb. thrust. The engine company is known to have concluded exhaustive aircraft design studies of multi-engined aircraft powered by a 7,000 lb. thrust turbofan having a fan ratio approaching 2:0. Fuel consumption of this engine, apparently, is on the order of 0.5 lb./hr.

The design study has been in progress by the group for about 18 months. De Havilland DH.121 aerodynamic data will be used extensively in the designs and may enable the company to sponsor an accelerated program akin to that developed for the Avro 748 if the market survey proves positive.

Examiner Proposes New Piedmont Route

Washington—Ozark, Lake Central and Allegheny airlines have been recommended for extensive route and operational authority improvements by a Civil Aeronautics Board hearing examiner.

The initial decision of Examiner James S. Keith, in the Piedmont Local Service Area Investigation, recommended permanent authorization for Ozark's services to Louisville and Clarksville/Ft. Campbell/Hopkinsville, Ky., and renewal for a five-year period of its authority to serve Owensboro, Ky.

New route segments were urged for Lake Central by Keith who recommended that the airline's routes be expanded to include segments from Terre Haute to Evansville, Ind., and between Cincinnati and Evansville.

Keith also recommended the addition of Nashville, Tenn., to Allegheny's route system from Huntington, W. Va., via the intermediate points of Lexington, Frankfort and Bowling Green, Ky.

DRAMATIC ANSWER TO THE AIR CARGO DILEMMA

Many air carriers, striving to answer perplexing questions presented by a growing air cargo industry, are facing a basic decision: should they convert outmoded piston engine passenger equipment and put it on to air cargo routes? Should they order proposed cargo jets with 100,000 lb. payloads? Should they wait for further turbo-fan evaluation before making their air cargo plane commitments?

Canadair's Forty Four, offers a simple, practical answer to these vital questions. It is an optimum-size, all-new, all-cargo turbo-prop airplane that, in terms of productivity, is vastly superior to converted piston engine equipment, and one that offers, in comparison with the big jets, a payload capacity that is not unrealistically high for profitable operations during the 1960's. Furthermore, the Forty Four suffers little or no operating penalties due to runway limitations, and there will be no community noise problems.

The Canadair Forty Four has a productivity two to three times that of converted piston aircraft, at the same cost per airplane mile, and has a profit potential that will quickly recover any losses on disposal of piston engine aircraft now being used or contemplated for cargo usage. On the other hand, the Forty Four with a payload capacity of 65,000 lbs. and low break-even point is ideally matched to the natural expansion of the cargo market and will begin immediately to operate at profitable load factors.

The Canadair Forty Four is flying now and is in production for the three largest all-cargo carriers in the United States, and can be introduced into existing fleets as early as January 1961.

The Canadair Forty Four can operate in and out of all airports presently used by four-engined piston-powered aircraft. For example, at such an important airport as Midway, in Chicago, with only 6400′ runways, the Forty Four can take off with 90% of its maximum payload and fly non-stop to San Francisco.

Sophisticated design features, including swing tail and integral cargo handling equipment, slash direct and indirect costs.

Step-by-step savings and economies inherent in the Canadair Forty Four, combined with its very attractive price, let precious capital dollars work for better return quicker than other "proposed" equipment.

Thus General Dynamics Corporation's Canadian subsidiary, Canadair, the specialist in air cargo, proposes the Forty Four as the answer to air cargo's biggest dilemma.

Principal Features of the Canadair Forty Four

1. Low prime cost—less than ⅔ the price of proposed jets.
2. Low operating costs—estimated at $1.30 per aircraft mile, and less than 4¢ per ton mile.
3. Right size for the 1960's—its present payload capacity is ideally matched to forecasted requirements.
4. No community noise problems—confirmed during present flight testing.
5. No airport or runway limitations—every major airport open to the Canadair Forty Four.
6. Growth potential—able to grow with the market.
7. Available for delivery in January 1961.

CANADAIR LIMITED, MONTREAL, CANADIAN SUBSIDIARY OF
GENERAL DYNAMICS CORPORATION

44
CANADAIR FORTY FOUR

AIRLINE OBSERVER

► Braniff Airways announced last week that it has given Boeing Airplane Co. a letter of intent to purchase three Boeing 720-027 transports powered by Pratt & Whitney JT3-C-7 turbojet engines. The order, which includes an option for a fourth 720-027, calls for delivery beginning in February, 1961. Cost of the fleet—including spares, parts, training and training aids, a flight simulator and supporting ground and shop equipment—will total about $15.5 million. Payment will be made from internally generated funds and neither long term debt nor additional equity is planned.

► Trunkline common stocks listed on the New York Stock Exchange have suffered seriously during the market's recent sieges of falling prices. None of the 10 carriers listed has shown any strength against the price drops, with the majority consistently setting new lows for the year during the early part of last week. Most observers feel that the sell-offs are an inevitable reaction to a declining market because of the low rate of return on most trunkline stock.

► Jet surcharges on North Atlantic flights will be extended 30 days beyond Mar. 31 as a result of an International Air Transport Assn. traffic conference agreement to keep current fares in effect until May 1, while current emergency negotiations of the traffic conference continue in Paris (AW Mar. 7, p. 333). Last month, British Overseas Airways Corp., Pan American and Trans World Airlines announced their intention of dropping the surcharge on Mar. 31, the date current fares were to have expired.

► Sabena Belgian Airlines will operate same-plane, through service between New York and Moscow on weekly schedules beginning Apr. 6 with Boeing 700-300 Intercontinental turbojet transports, first U. S.-built jet to serve the Russian capital in scheduled service. Making one stop at Brussels, Sabena will cover the east-bound route with a scheduled flight time of 9 hr. 45 min.

► Vickers-Armstrongs Vanguard 950 Mk. 2 turboprop transport specifications for gross takeoff weight have been increased by 5,500 lb. to 146,500 lb.; maximum landing weight has been hiked to 130,500 lb. from 121,000 lb. Maximum zero fuel weight has been boosted by 10,000 lb. to 122,500 lb., and payload has been set at 37,000 lb., an 8,000 lb. increase.

► Watch for Continental Air Lines to place an order for a fifth Boeing 707 turbojet transport for delivery this spring. Plane is now at Boeing's Renton plant with Continental markings and configuration awaiting completion of contract negotiations.

► Lufthansa-German Airlines has contracted with Lockheed Aircraft Service for the conversion of two Lockheed 1649A Constellations to all-cargo planes. Aircraft will have a transatlantic payload of 37,250 lb., a rear door measuring 106½ in. wide and 72 in. high, a forward door 56½ in. wide and 72 in. high.

► United Arab Republic aviation authorities have dropped plans to merge privately-owned Syrian Airways with government-owned Misrair because of strong opposition to the proposal by Syrian business circles. On the strength of assurances from UAR President Nasser that Syrian Airways will be permitted to operate in free competition with Misrair despite its refusal to merge, the airline plans to add Douglas DC-6Bs to its present fleet of Douglas DC-4s.

► Aeroflot, Soviet state-owned airline, has informed its personnel that the depreciation period for obsolete Il-12s and Il-14s must be extended since the piston-powered aircraft will "still be widely used for the next three-four years." The carrier's State Scientific-Research Institute says inspections made on the Il-12s and Il-14s that have flown 13,500-14,500 hr. show that comparatively minor work (principally on the skin of the wing root) is necessary to ensure 20,000 hr. safe operation if the plane's structure has not been affected by intercrystalline corrosion. Until recently, the Il-12s' depreciation period had been set at 15,000 hr.

SHORTLINES

► **Aeroflot**, the Soviet state-owned airline, reports that it carried more than 50,000 foreign tourists over its domestic routes in 1959 for a new foreign traffic record within the USSR.

► **Continental Airlines** has signed an agreement with the Diner's Club, Inc., to honor the latter's credit cards in purchasing airline tickets. Northeast Airlines and Western Air Lines already have signed similar agreements with the Diner's Club.

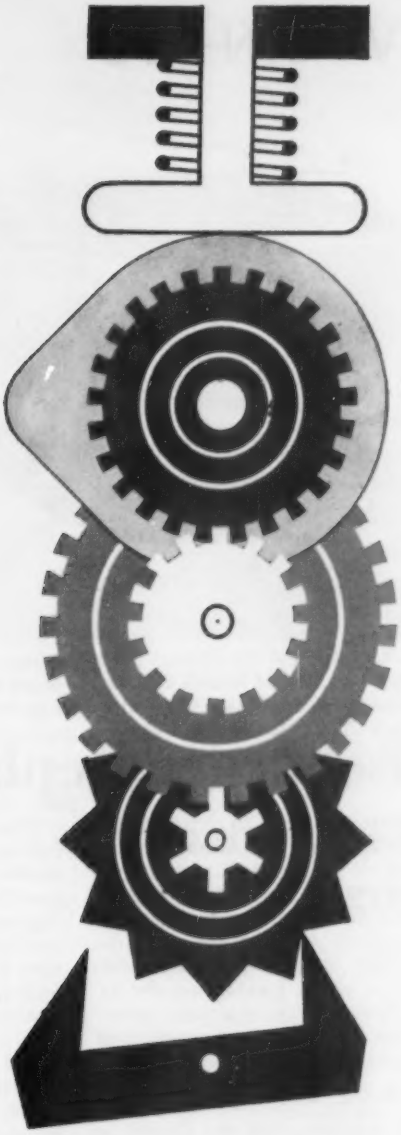
► **Hawaiian Airlines** reports a profit of $31,000 for the last quarter of 1959. The carrier reports that this marks the first time it has realized a profit for the October-November-December period. Both inter-island and transpacific contract operations contributed to revenues of $2,073,000 for the period as compared with $1,515,000 collected in the fourth quarter of 1958. Largest revenue gain was in inter-island passenger revenue, up $366,000, half of which was attributed to sightseeing flights over the erupting Kilauea Iki volcano.

► **Japan Air Lines** and Air France have signed a formal agreement to operate jointly between Tokyo and Europe via the polar route beginning Apr. 1. Air France Boeing 707-320 turbojet aircraft will be used until JAL's Douglas DC-8 turbojets are placed in service on the polar route in the spring of 1961. The agreement also provides for an eventual similar joint venture on the southern route to Europe from the Orient.

► **Real Airlines of Brazil** has added a second weekly flight from Sao Paulo to Los Angeles via Bogota and Mexico City.

► **Trans-Texas Airways** has become the first U.S. domestic airline to honor American Express credit cards. The agreement provides for transportation by Trans-Texas only and does not apply to interline or transfer transportation. Trans-Texas says it chose the American Express plan because there are approximately 100,000 card holders in its area.

► **Trans World Airlines** will double its daily nonstop turbojet service between New York and London and Paris on its summer schedules. Effective Apr. 24, TWA will add three weekly Boeing 707 flights from New York to London and one daily flight from New York to Paris which will continue on to Rome. On May 18, TWA will add four more weekly flights to London, providing for twice daily nonstop service to both London and Paris.



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Bulova capability can make a whole lot of difference in the success and reliability of your program—commercial or military.

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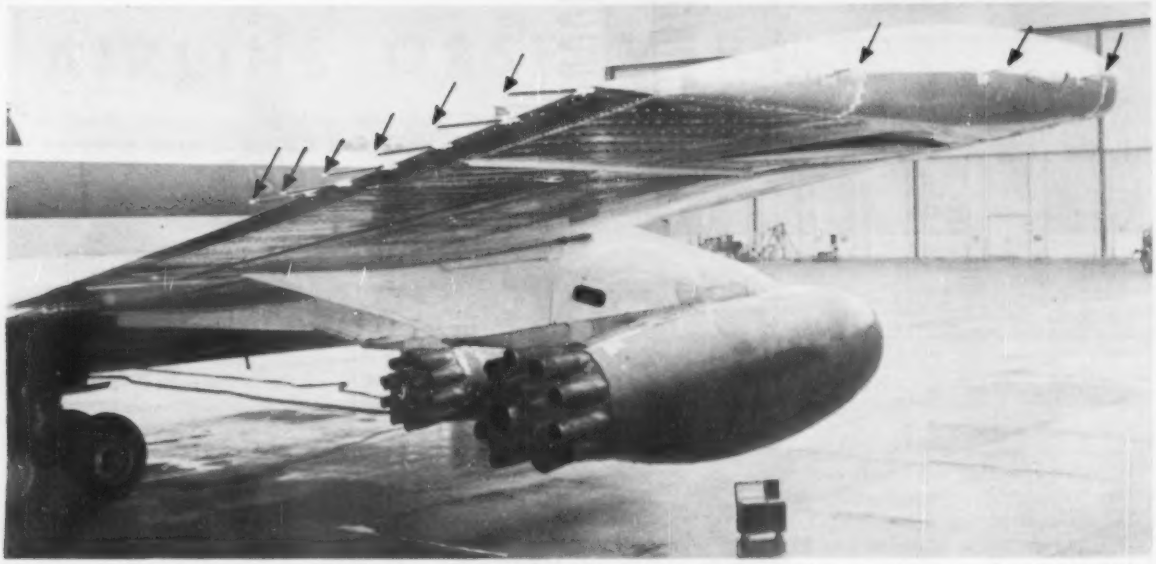


NEW type static dischargers (arrows), installed on trailing edges and tips of wings and tail surfaces, promise to greatly reduce precipitation static from corona discharge. New devices, developed by Stanford Reseach Institute and tested by Boeing on a 707, will be installed on new jet transport going to Qantas Empire Airways for service evaluation. Other jet makers are interested.

Corona Static Discharger Replaces Wicks

By Philip J. Klass

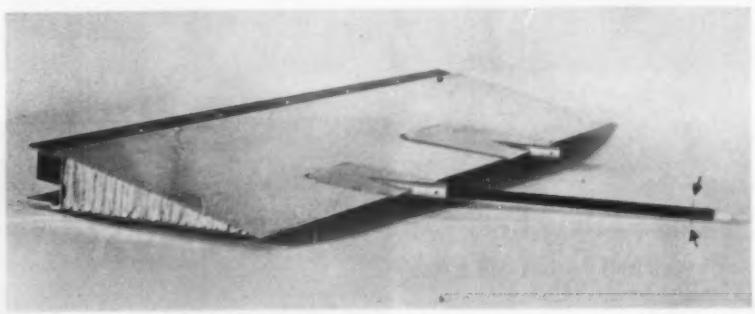
Menlo Park, Calif.—A Boeing 707 jet transport, to be delivered to Qantas Empire Airways, will be the first airliner to be equipped with a new type of corona discharger which promises to greatly reduce precipitation static in airborne radio receivers. Other jet airliner manufacturers reportedly also are contemplating using the new device.

The aircraft static discharger, which replaces the long used discharge wicks, was developed by Robert L. Tanner of Stanford Research Institute and was first reported by AVIATION WEEK (Apr. 29, 1957, p. 73). It has undergone several years of testing by Stanford Research Institute and Boeing on the latter's 707 prototype aircraft.

Precipitation static, which results from the discharge of an electric charge accumulated by an aircraft striking charged air and moisture particles, has long been a problem. The problem has assumed more serious proportions on jet transports because of the recent discovery that the jet engines themselves produce a charge build-up on the aircraft which results in periodic corona discharge and consequent interference with radio communications.

New Static Dischargers

The installation on the Qantas jet transport will consist of approximately 21 of the new type static dischargers mounted on the trailing edges of the wing, elevator and rudder, with a dozen of a smaller, slightly different type of discharger installed along the tips of the wing and horizontal stabilizer.



STATIC discharger (above) is for installation on trailing edge of wing and tail surfaces. Tungsten needles provide corona discharge points which are connected to the airframe.

The dischargers installed along the trailing edges consist of two tungsten needles mounted near the end of a glass fiber rod measuring 10-12 in. long. The rod is coated with a resistive (conducting) material and is attached to the wing by means of a metal sleeve. The wing tip discharger consists of a small triangle of glass fiber, mounting two small tungsten needles which are connected to the metal base through a resistive coating.

The new static discharger design is the result of studies of the basic mechanism by which corona discharge produces severe static in airborne radio receivers. These studies indicated that there was very good radio frequency coupling between the radio antenna and the airframe at precisely the same locations that corona discharge usually occurs, i.e., wing and tail extremities. This means that corona discharge static has a convenient path into the antenna and thus into the radio receiver.

There are, however, two locations where this coupling, or RF field, is zero. If the corona discharge can be made to occur at these locations, little if any of the static will be transferred (coupled) into the antenna and radio receiver.

The new type static dischargers provide the means for shifting this discharge point aft of the trailing edge to where the RF coupling is essentially zero. The aircraft's charge travels to the two tungsten needle discharge

points along the resistive coating which runs between the wing/tail surface and the needles.

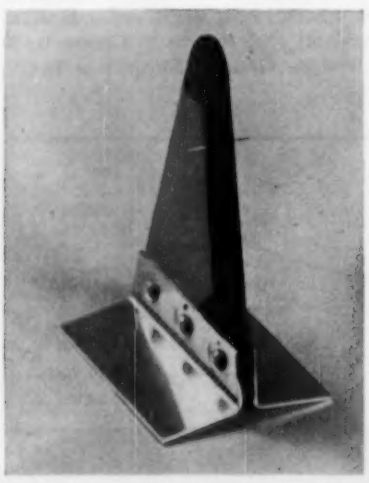
Insofar as discharge energy is concerned, the needles are effectively connected directly to the fuselage. But at radio frequencies, the relatively high resistance of the coating and the capacitance between the needles and fuselage make the discharge points appear to be isolated from the fuselage.

Originally Tanner contemplated isolating the trailing edge of the wing or tail surfaces by using a glass fiber section which was coated with resistive material, with the discharge needles located in the isolated aft portion of the wing. Tanner's latest approach uses individual static dischargers which perform the same function but which eliminate structural problems and permit easy retrofitting of existing aircraft.

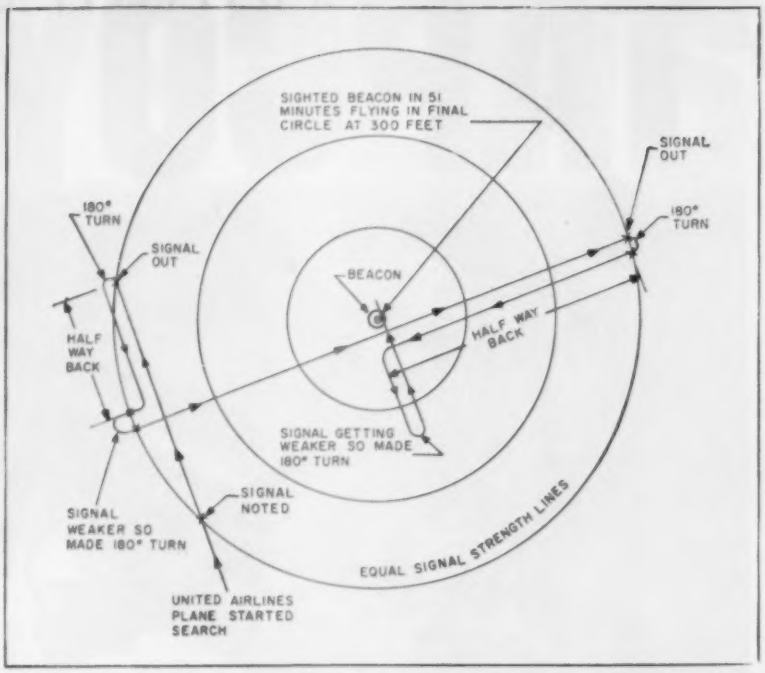
Flight tests made by Boeing and SRI during the last two years disclosed the vortices at the wing tips produced localized low-pressure areas in which corona discharge could take place, in addition the familiar locations along trailing surface edges. This led Tanner to develop the smaller triangular-shaped dischargers for the wing tips.

Original studies which led to the new corona discharger design were sponsored by Air Force Cambridge Research Center. Initial flight tests were financed by Wright Air Development Division, but when the program was hit by defense budget cutbacks in 1957, Boeing agreed to provide company funds.

The effectiveness of the new static dischargers, as demonstrated in flight tests, and their relatively low cost, prompts Tanner to believe that all of the jet aircraft and many of the existing piston engine aircraft will replace the old discharge wicks with the newer devices.



WING tip installation for static discharger shows airframe coupling.



SEARCH pattern which can be used by airliners and other aircraft not equipped with VHF direction finder, employing only normal VHF communications receiver. Using this search pattern, a DC-7 located downed beacon in United Air Lines tests in less than an hour.

Miniaturized Rescue Beacon Starts Sending Signals on Water Impact

Palo Alto, Calif.—Small, lightweight life raft rescue beacon, which automatically erects its own antenna and starts transmitting on the international distress frequency of 121.5 mc. as soon as it hits the water now is being installed on United Air Lines' Douglas DC-8 aircraft used on the route to Hawaii.

The new miniature rescue beacon, which weighs only 9¼ lb. including water-activated batteries, will operate continuously for more than two days on its battery supply. Operating in the VHF band, the beacon can be heard at ranges of nearly 150 mi. by aircraft flying at an altitude of 10,000 ft.

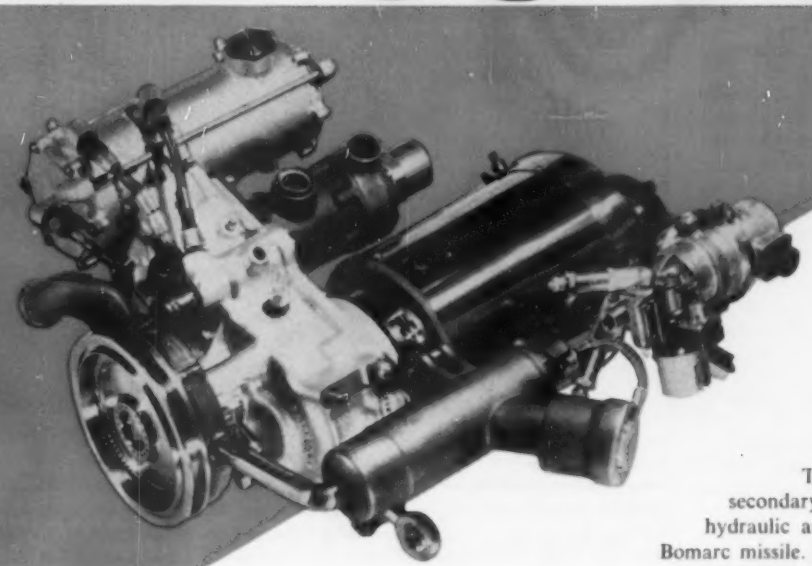
The beacon was developed here by Granger Associates, in close cooperation with United Air Lines, which recently completed operational tests on the device off Princeton, Calif. Because the rescue beacon operates in the VHF band, any aircraft in the area equipped with conventional VHF communications receivers can locate the beacon in less than an hour by following a special search pattern (see sketch), United's tests indicated. Coast Guard aircraft, equipped with VHF direction finding equipment, can locate the beacon far more quickly.

The UAL-Granger rescue beacon development is an outgrowth of increasing airline concern over the value of the AN/CRT-3 (Gibson Girl) rescue beacon that has been standard equipment on overwater flights. The Gibson Girl is so large and bulky (36 lb.) that it is stored in the aircraft and must be removed after ditching, a sometimes impossible task.

A kite must be assembled or a balloon inflated with hydrogen to hoist the 300-ft.-long antenna into the air and the ground lead must be placed in the water. Then the device must be cranked by hand to transmit the distress signal. All this must be accomplished by survivors who frequently are inexperienced

NEW sea rescue beacon, developed by Granger Associates, will be used on all United Air Lines DC-8s flying to Hawaii. Beacon weighs only 9¼ lb. is fully automatic, with antenna snapping into position when unit hits water. The beacon transmits on 121.5 mc., has range of 150 mi., operates for 48 hr.

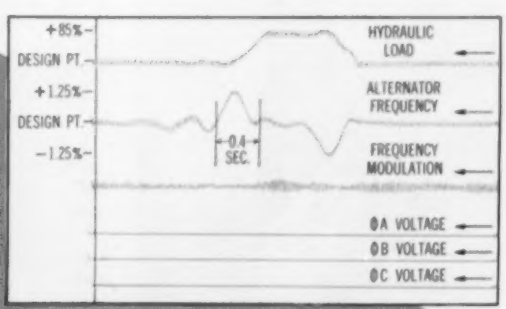
TAPCO POW



BOMARC APU

This APU is a self-sufficient secondary power unit which provides hydraulic and electrical power for the Bomarc missile. It maintains constant speed and recovers very rapidly from sudden changes in load demand. The turbine-driven unit utilizes energy obtained from the decomposition of a pre-packaged monopropellant fuel. Unique features include a pressurized fuel system which eliminates fuel pump requirement, all-altitude lubrication system, and a constant speed electro-mechanical control not affected by load demand. The unit is now undergoing Military Preflight Rating Test.

This trace shows the ability of a combined electrical and hydraulic power system to generate high quality electric power when subjected to large changes in the hydraulic load. Note that the transient response occurs within 0.4 sec. and that maximum excursion of electrical frequency is 1.25% of the steady state value. The steady state frequency is below 0.1% and the voltage modulation is 0.14%.



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20 H.P. SOLID FUEL GAS GENERATOR

This solid fuel gas generator was developed for use with either composite or double-base type fuels. The operating pressure is 550 PSI, the power duration is 2 minutes. Operating environment from -65°F to +165°F. A special TRW-developed energy transition design insures excellent ignition characteristics and reliable operation.

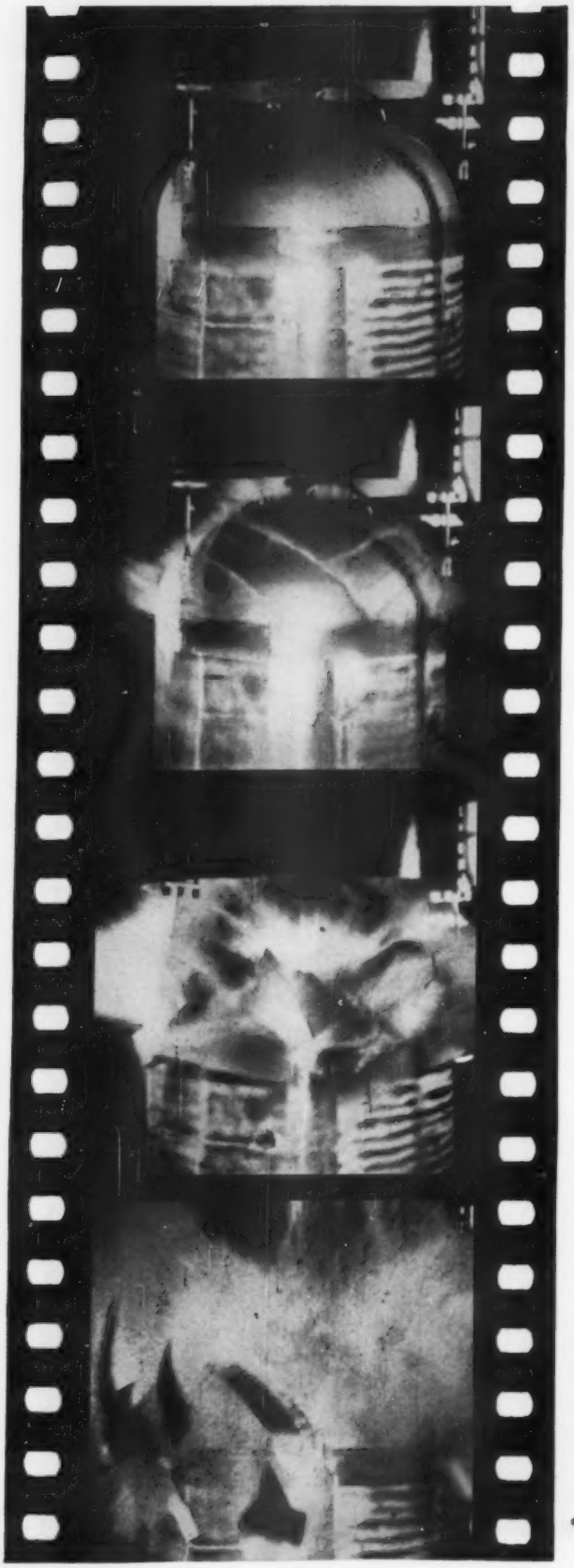
HYDRAZINE GAS GENERATOR

Currently in active service are TAPCO-designed and produced lightweight hydrazine gas generators ranging from 50 to 12,000 h.p. These generators are capable of withstanding severe G-load and vibrational requirements during sustained operation. TAPCO facilities are completely integrated for the economical development and manufacture of gas generators, with very short lead time required.

RE-ENTRY TURBINE

The re-entry turbine is a new concept that allows lower specific fuel consumption by re-circulating gases through a single turbine wheel. Unit shown, with integral solid-propellant gas generator, is in final stage of development.

Graph below shows Specific Fuel Consumption as a function of power with single and 2-pass turbines. Note improved performance with the re-entry turbine.



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BURST TEST*

Time zero—a rocket motor case header, over five feet in diameter, fragments in a Budd Company laboratory.

This case was fabricated by advanced techniques created and developed by Budd scientists.

Your problems deserve the fresh and vigorous thinking available at the SpaceAtomics Division of The Budd Company, Philadelphia 32, Pa.

SPACEATOMICS Budd DIVISION

*Film sequence taken at intervals of 1/64 of a second.

in such matters, perhaps injured and/or panic-stricken.

An analysis of more than 30 recorded forced landings in the Pacific during the past decade, made by Cdr. Henry M. Anthony, chief of communications for Coast Guard's western area, shows only four instances where military survivors were able to launch Gibson Girl kites and/or balloons to hoist its antenna, and only three instances where distress signals were received by search and rescue units.

In Cdr. Anthony's opinion, to use a Gibson Girl successfully requires "manpower, stamina, perseverance, experience, ideal wind and sea conditions and luck."

Practically all of these are eliminated in the case of the new Granger Model 117 rescue beacon. The beacon is small enough to be attached directly to the life raft and will be available if any life raft is ejected. Because the beacon goes into operation automatically, it can serve to pinpoint the location of a crash even if there are no survivors, or if survivors are badly injured.

Because the beacon operates at VHF frequencies, it needs only a small antenna, about 15 in. high. The spring-mounted antenna is folded back against the body of the beacon and held in this position by straps which dissolve in water, allowing the antenna to snap into erected position. The beacon measures approximately 4 x 4 x 29 in. with antenna folded back.

The beacon itself is designed to float, and its base is weighted so that it will assume an upright position for proper antenna orientation. United Air Lines tests included the towing of the beacon at speeds corresponding to those which might be experienced in a drifting life raft to be sure the beacon would remain upright and would continue to function.

Operation in the VHF band not only assures reliable all-weather operation, but permits the beacon to operate with very modest power output, about 0.7 watt, yet achieve ranges of about 150 mi. Transmitter is crystal-controlled to assure stability.

Any airliner or aircraft not equipped with a VHF direction finder can locate the downed beacon by flying the following search pattern. Search pilot notes time when the beacon signal is first detected, continues flying in same direction until the signal fades out and notes total elapsed time since the signal was first detected. The pilot then executes a 180 deg. turn, flies back for half of the previously elapsed time interval, then makes a 90 deg. turn and notes whether the signal gets stronger or weaker.

If the signal gets stronger, the pilot continues in the same direction; if it gets weaker he executes a 180 deg. turn. In either event the pilot flies until the signal again fades out, noting total elapsed time since he made the last turn. The pilot again makes a 180 deg. turn and flies back for half of the elapsed time, then executes a 90 deg. turn and notes whether the rescue beacon signal get stronger or weaker. If it gets stronger, he continues in the same direction; if it gets weaker, he makes a 180 deg turn. This sequence of maneuvers should bring searching aircraft over the rescue beacon or within visual sight of the life raft.

FAA's Evaluation of Decca Mk. 10 Was Based on Opinion, Decca Says

Washington—Sharp criticism of the Federal Aviation Agency study of the Decca Mark 10 system as a fixed-wing aircraft navigation aid, coupled with a plea for a direct comparison of VOR/DMET with its Mark 10, was issued recently by the Decca Navigator Co., Ltd.

The firm charged that the unfavorable FAA evaluation (AW Jan. 11, p. 33; Feb. 22, p. 43) was based on opinion, not fact. It detailed its case with a point by point criticism of the major shortcomings of Decca Mark 10 cited by the FAA and the nature and structure of the questions asked of the evaluating pilots.

Decca withheld comment, however, on the main body of the FAA report dealing with an evaluation of the Decca Mark 8 in helicopters because, the firm said, the FAA is in the midst of the second phase of its trials.

A conclusion that VOR/DMET is a more suitable system than Decca cannot be inferred from FAA evaluation, Decca charged, because the former was not subjected to a simultaneous evaluation with Decca during the trials.

"It seems indisputable to us," Decca's rejoinder to the FAA study says, "that this FAA document reveals a clear and urgent requirement for the two systems—VOR/DMET and Decca—to be evaluated side by side on a direct comparison basis. Until this is done, we believe the question will never be satisfactorily resolved."

Some of Decca's replies to specific points raised in the FAA study are:

• **Deviations of the tracking** pen on the flight log display causing "incorrect navigation information . . ." as charged in the FAA report, did not exceed plus or minus 0.5 naut. mi. with the exception of the chart of the Boston area, Decca says.

• **Cause of the loss** of zone identification at intermediate ranges where satisfactory coverage was expected was diagnosed before the conclusion of the flight tests, and although improved results were obtained after a receiver adjustment, the better results were not mentioned in the report, Decca says.

• **Pilot's answers** to the question, "did you find it possible to home on reporting points off the printed airways?" (48% yes; 5% no: 47% no comment), contradict the FAA conclusion that a preprinted course is required to give the pilot sufficient position accuracy for holding and homing between fixes, Decca charges. Airline pilots using Decca, the firm claims, can fly holding patterns "to a degree of accuracy and safety unmatched by any other system or combination of systems."

• **From European operating** experience, Decca points out, it cannot imagine any circumstances under which it would be necessary for two pilots to operate the Decca and the aircraft itself simultaneously, as charged by FAA.

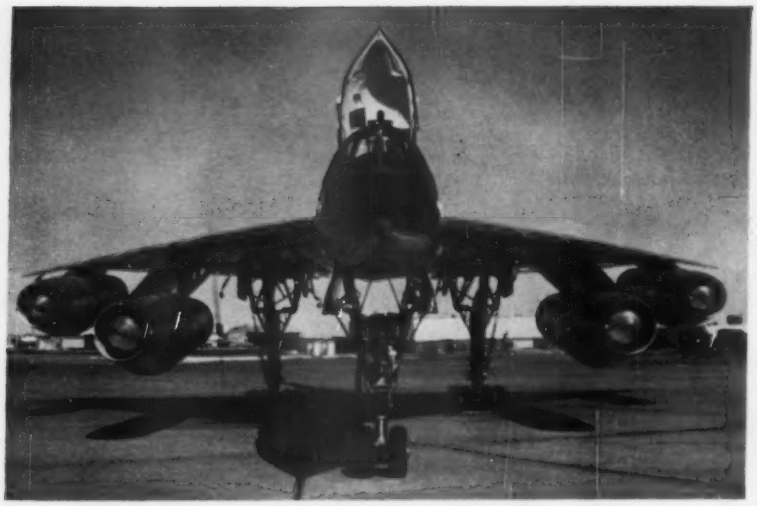
• **Pilots' answers to four** questions is the basis for the FAA conclusion that Decca does not provide steering information, forcing pilots to resort to other navigation aids, Decca says. The conclusion cannot be deduced from these questions, the firm claims. The four questions and answers were: "Did the zone identification work properly? (48% yes; 37% no); Were you able to say within omni-airway structure (9 naut. mi.)? (23% yes, 62% no); Were you able to navigate by use of Decometers only? (28% yes, 35% no); and at any time did the flight log geographical representation cause difficulties? (21% yes; 5% no)."

In regard to the pilots' answers to questions, Decca made these points among others:

• **Nature of the question,** "Were there any discrepancies between Decometers and the flight log after referencing?" (24% yes; 64% no) invites a "yes" answer no matter how insignificant the discrepancy:

• **Similarly, the question,** "Were there any unaccountable excursions of the flight log during flight?" (52% yes; 35% no) and on ground? 10% yes; 47% no), does not provide quantitative indications of the size or significance of the excursions and permits the pilot to answer yes regardless of the magnitude of the excursion.

• **Question and answers** to "Did the flight log require resetting? Present difficulties? When? (a) Entering a Decca area? (b) In fringe areas? (c) Changing charts? (d) Changing chains?" are confusing. Also, flight tests were not necessary to determine what was



The B-58 Hustler, America's first supersonic bomber, is now in production for the U. S. Air Force at the Fort Worth, Texas, Plant of the Convair Division of General Dynamics Corporation. Carrying a crew of only three, the B-58 is designed to operate at altitudes above 50,000 feet and is powered by four General Electric J79 turbojet engines.

Sprague Awarded Contract For Engineering Assistance On B-58 Hustler

The abundance of electronic equipment fitted into the small, dense, supersonic B-58 Hustler calls for comprehensive interference control engineering. To obtain on-the-spot assistance for this extremely complex engineering problem, the Weapon System Manager for the Mach 2 bomber at Convair's Fort Worth Plant has awarded a special contract to the Interference Control Field Service Department of the Sprague Electric Company.

Under the terms of the contract Sprague will assist Convair with the integration of both electrical and electronic equipment of airborne and ground systems into an even more effective and reliable weapon system. Sprague staff engineers assigned to the project are already at work at the Fort Worth Plant.

Sprague Interference Control Laboratories located in Dayton, Los Angeles, and North Adams, are supporting the Convair program as testing and sampling facilities. These laboratories are staffed by top interference and susceptibility control specialists, and are equipped with the most advanced instrumentation and model shop facilities.

For assistance with your Interference, Susceptibility, and Integration problems, write Interference Control Field Service Manager, Sprague Electric Co. at 12870 Panama Street, Los Angeles 66, California; 224 Leo Street, Dayton 4, Ohio; or 327 Marshall Street, North Adams, Massachusetts.

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freely conceded in Decca equipment instructions; namely, that the flight log must be reset when (a) Entering a Decca area (b) Changing charts and (c) Changing chains. Only 18% of the pilots indicated difficulties in changing chains compared with 47% encountering difficulty when changing charts even though the former also involves a chart change.

Decca concludes that at least some of the questions were "leading" and that the percentage of "no comments" is "absurdly high" and should have prompted FAA to rephrase the questions.

FILTER CENTER

▶ **What's in a Name**—Moletronics Corp. is the new name for the Hymac Corp., electronic test equipment manufacturer which recently was purchased by Minneapolis-Moline Co. The term "molectronics" usually is used for molecular electronics.

▶ **Pressure Transducer**—All solid-state pressure transducer, "the size of four dimes stacked on end," will be unveiled this spring by Giannini Controls Corp., according to Donald H. Putnam, president. Initially the transducer will be used to detect pressure changes around helicopter blades, but eventually applications should broaden. Similar multipurpose transducer was developed recently at International Dynamics Corp. (AW Jan. 11, p. 93).

▶ **Signed on the Dotted Line**—Major contract awards recently announced by avionics manufacturers include:

- **United Testing Laboratories,** Monterey Park, Calif., $375,000 contract from Wright Air Development Division for environmental testing of electronic and electromechanical components in accordance with military specifications.
- **Sylvania Electric Products, Inc.,** $600,000 award from Bureau of Naval Weapons for production of low-altitude radar altimeters, APN-117, for helicopters. This is second production contract for APN-117 received in past six months.
- **Telecomputing Corp.,** Los Angeles will furnish research and developmental data reduction services at Holloman Air Force Base, Alamogordo, N. M., under a $2,084,222 contract from the Department of the Army.
- **Electro-Optical Systems,** Pasadena, reports a $75,633 contract for a Microbaroswitch from Army's Los Angeles Ordnance District.
- **ACF Industries,** Electronics Division, Riverdale, Md., a $1.1 million contract from Naval Training Devices Center for conversion of P5M-1 flight and tactics simulator into newer P5M-2.

NEW TRAIL SENSE FOR PILOTS ON THE PROWL

The horizon is always clear for the F-105 Thunderchief with NASARR... the compact, lightweight monopulse radar system designed and built by Autonetics. NASARR gives the Republic Thunderchief an uncanny sixth sense for air-to-air search, automatic tracking, air-to-ground ranging, ground mapping, and terrain avoidance—regardless of height, speed, attitude, or visibility. For more than a decade Autonetics has pioneered the way with monopulse radar systems like NASARR to give America's pilots the keenest trail sense possible.

Armament Control Systems by Autonetics

DOWNEY, CALIFORNIA

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INERTIAL NAVIGATION / ARMAMENT AND FLIGHT CONTROL / COMPUTERS AND DATA SYSTEMS

Marquardt ADVANCED PRODUCTION CAPABILITY for air and space

MARQUARDT/OGDEN RAMJETS FOR USAF-BOMARC PROVE 100% RELIABLE

Marquardt/Ogden delivered its first production engine to the Air Force in June 1957, one month ahead of schedule. This was achieved despite the problems of creating, building and implementing a modern production facility and staffing it with qualified engineers and technical personnel. In the more than two years since, each and every delivery has been as-per-contract-schedule, while Ogden ramjets have proved 100% reliable in all test flights of Bomarc IM-99A.

By strict adherence to a realistic learning curve, Ogden Division currently delivers its supersonic ramjets at far less than their mid-1957 delivered cost—this despite the ramjet engine system's relatively early stage of maturity.

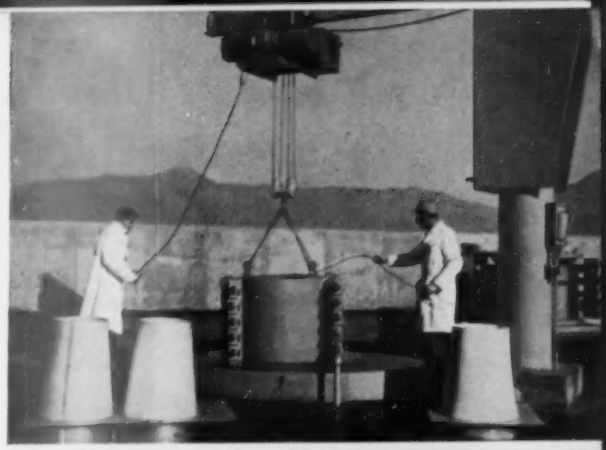
Recent expansion and additions further enhance Marquardt/Ogden's capability. In 1958 the plant doubled floor space to almost ¼ million square feet, with numbers of employees increasing 93%. 1959 marked Ogden Division's addition of a first-of-its-kind Spin Forge and completion of a new facility for explosive metal forming. Ogden's USAF-Marquardt acceptance test facility at Little Mountain gives the Division full-plant capability.

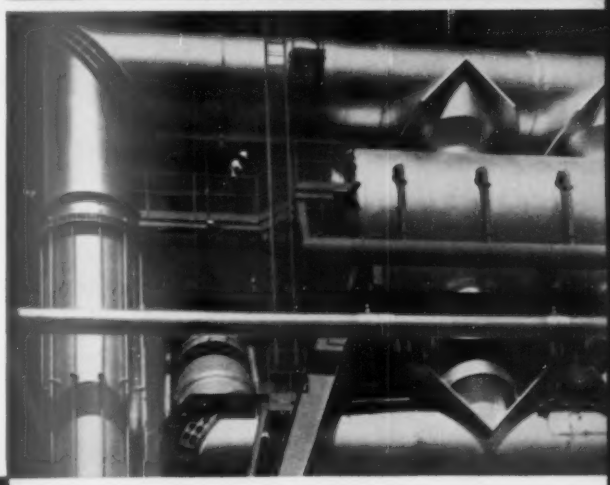
Marquardt/Ogden is now capable of producing space-age hardware in all of its basic configurations—cones, cylinders, rings, parabolic shapes—using the most sophisticated of space-age metals.

Responsible for Marquardt/Ogden's record are: a creatively cost-conscious management team headed by Mr. D. K. Tasker (pictured left); early application of industry's newest and most advanced production and metal working techniques; a facility cited by *Factory Magazine* as one of America's top ten; and the efforts of the Division's nearly 2,000 men and women workers. All combine to provide Department of Defense and Weapon Systems Managers with a unique capability for the on-time delivery of reliable space-age hardware at minimum cost.

For additional production capability specifics, you are invited to contact: Manager, Customer Relations Department, Ogden Division, The Marquardt Corporation, 1000 West 33rd Street, Ogden, Utah.

Current expansion creates a number of outstanding opportunities for: Product Development, Materials and Process, Manufacturing and Production Test Engineers; and skilled machinists.





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TOP. High energy (explosive) forming produces heretofore "impossible to form" shapes—typifies Marquardt/Ogden's continuing quest for optimum materials and processes which advance the art of metal fabrication.

CENTER. Marquardt/Ogden's massive Spin Forge is the most powerful of its type for cold-flow forming of space-age metals. It compliments the Division's new explosive metal forming facility and other specialized equipment.

BOTTOM. USAF-Marquardt Jet Laboratory-Ogden at Little Mountain, some 15 miles West of Ogden, acceptance-tests every production engine system produced by the Division; is capable of simulating flight at speeds in excess of Mach 3, altitudes above 100,000 feet.

THE NEW
IN VIEW!

At Martin-Denver exciting and vast new space engineering programs are in progress. These programs demand unusual creative talent. If you have this talent and want rapid professional advancement, please make this known to N. M. Pagan, Dir. of Tech. & Scientific Staffing, (Dept. CC8), The Martin Company, P. O. Box 179, Denver 1, Colorado.

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MARTIN-DESIGNED CIRCULAR SPACE COMPUTERS ARE AVAILABLE **FREE** TO INTERESTED PERSONS BY WRITING TO THE SAME ADDRESS.

AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts for $25,000 and over as released by the Air Materiel Command.

Phaostron Instrument and Electronic Co., South Pasadena, Calif., 489 ea., indicators, ID-251B/ARN and spare parts for Navy and USAF retrofit aircraft, (MIPR R60-3633-14-NOas, PR MD-9-5826-37023 and amendment No. 1), $149,634.

Westron Instrument Division, Daystrom, Inc., Newark, N. J., 209 ea., indicators, ID-526A/ARN, Aerno 81-3376 (used with the ARN/ASN-7 navigation computer installed in B-58, F-101B, et al aircraft, (PR's EC-9-16K1-4576, EC-9-6605-6146 and amendment No. 1 and 00-0-IAGU-6605-4572), $432,620.

Thomas A. Edison Research Laboratory Division, McGraw-Edison Co., West Orange, N. J., six ea., pressure transmitters, high temperature, radiation resistant in accordance with exhibits WCLCI-1-273 dated Oct. 1, 1958, WCLCI-3-13 dated Sept. 25, 1958 and WCLCI-3-7 dated Aug. 20, 1958, for service test for which end use is unknown, (PR EA-9-ST-05D-4873), $49,263.

Red Bank Division, Bendix Aviation Corp., Eatontown, N. J., 273 ea., generators, 200 amp., v.d.c., type MA-1, Aerno 42-2028, engineering and maintenance data, use in installations for Q2C drones and spares for H-37A aircraft, (PR EA-0-6115-6073 and amendment No. 1), $172,268.

Avien, Inc., New York, 128 ea., indicators, temperature, thermocouple, type EHU-9/A, Aerno 61-2505 for use on T-38A aircraft, (PR EA-0-6685-6181 and amendment No. 1), $137,550.

Republic Aviation Corp., Farmingdale, L. I., N. Y., spare parts, special tools and ground handling equipment for program implementation of F-105D aircraft, (PR TF-0-1510-5011 and amendment No. 2), $7.5 million.

Santa Barbara Laboratory, Raytheon Co., Santa Barbara, Calif., two countermeasures sets, AN/ALQ-25(XY-3), two sets of mounting racks and two sets of installation cables for support of research and development project 5197, (PR DN-9-01A-7749), $97,360.

Link Aviation, Inc., Binghamton, N. Y., 35 ea., T-37 training flight simulators, type AF/F 37A-T4 in accordance with military specification MIL-T-26337A (USAF) dated Dec. 19, 1958 and amendment No. 1 dated July 10, 1959, spare parts, ground support equipment, data and services, (PR TR-0-28-5910 and amendment No. 1), $1,300,000.

Hughes Aircraft Co., Culver City, Calif., continued development of AN/ASG-18 fire control system and GAR-9 air-to-air missile, (PR 47814), $1,250,000.

AiResearch Manufacturing Co., Arizona Division, The Garrett Corp., Phoenix, Ariz., 248 ea., starters, pneumatic, aircraft engine, USAF type MB-3, Aerno 42-9400, and data for use on KC-135, KC-135A and F-100F aircraft, (PR's EA-9-2995-4981 and EA-0-2995-6078 and amendments 1 and 2), $282,-100.

AiResearch Manufacturing Co., Arizona Division, The Garrett Corp., Phoenix, Ariz., 140 ea., starters, pneumatic, aircraft engine, USAF type STU-1/A, Aerno 42-9409, spare parts and data for use on C-130B aircraft, (MIPR R59-2160-117-NOas and amendment No. 1, PR EA-0-03J-6013), $245,000.

Collins Radio Co., Cedar Rapids, Iowa, components of the MA-1 flight director system; 133 ea., indicators, horizon approach, Aerno 60-1900; 172 ea., indicators, course, Aerno 60-1901; 125 ea., gyros, vertical, Aerno 60-1902; 147 ea., gyros, monitor indicator, Aerno 60-1903; 142 ea., computers, steering with Shockmount, Aerno 60-1904; Aircraft usage: C-130A, C-130B, RC-130A, SC-130A, UC-118 and F-106 simulators, (PR's MA-9-05C-1230, 1194 and 1229; MA-9-6610-1108; EA-0-6610-6071; ES-0-6610-6278; ES-0-6615-6279), $268,928.

Warner Lewis Co. Division, Fram Corp., Tulsa, Okla., filter/separator modification and conversion kits, (PR's EM-0-4930-6140, EM-0-2330-6143 and EM-0-2330-6144), $1,-463,072.

Navy Contracts

Following is a list of unclassified contracts for $25,000 and over as released by U. S. Navy contracting offices:

BUREAU OF AERONAUTICS, DEPARTMENT OF THE NAVY, Washington 25, D. C.

Ansul Chemical Co., Marinette, Wis., 5,440 recharge kits for trimethoxyboroxine (TMB) extinguishers installed on MB-5 crash, fire and rescue trucks, NOas 60-4097-f(SE-73-1148-0), $53,094.

Hamilton Standard Division, United Aircraft Corp., Windsor Locks, Conn., 44 propeller systems for aircraft and 18 blades in accordance with contractor's summary specification 2664C, NOas 59-8066-f(PD-41-1953-9), $2,778,676.

Audio Producers, Inc., New York City, preparation of master shooting scripts with storyboard and production of four 35mm. black and white, sound motion picture training films in accordance with joint Army-Navy specification JAN-P-55 and amendment No. 1 thereto, NOas 60-8023-f(PH-5-2137-60), $83,643.

Dynamic Electronics-New York, Inc., Richmond Hill, N. Y., 60 man months of field engineering services for electrical and electronic equipment, NOas 60-4061-s(MA-60-622-0), $63,217.

Chicago Aerial Industries, Inc., Melrose Park, Ill., 24 man months of field engineering services for cameras and camera installations, NOas 60-4025-s(MA-60-590-0), $31,526.

Westinghouse Electric Corp., Washington, D. C., services and materials for performing and analytical overhaul and repair program on government-owned model J34-WE-46 engine accessories, NOas 60-0169-f(MA-33-388-59), $213,002.

Hamilton Standard Division, United Aircraft Corp., Windsor Locks, Conn., 52 blade assemblies and 10 propeller assemblies in accordance with applicable portions of specifications MIL-P-5447A(ASG), NOas 60-0192-f(PD-41-3942-0), $284,354.

DEPARTMENT OF THE NAVY, BUREAU OF NAVAL WEAPONS, Washington, D. C.

Republic Steel Corp., Massillon, Ohio, materials, services, facilities and personnel necessary to establish satisfactory procedures for producing improved titanium alloy sheet, NOas 60-6054-c(AE-41-4784-9), $95,500.

Foster D. Snell, Inc., New York City, research and development of a satisfactory sprayable strippable material(s) for use as a protective coating for aircraft, missiles and rockets, NOas 60-6063-c(AE-42-2329-0), $25,000.

Phillips Petroleum Co., Bartlesville, Okla., relationship between jet fuel stability in terms of short term thermal stability and gum content, NOas 60-6009-c(PP-41-2868-0), $54,415.

Tech Rep Division, Philco Corp., Philadelphia, Pa., 104 man months of field engineering services for radar air traffic control system, NOas 60-0183-s(SE-61-5159-9), $92,522.

Bell Helicopter Corp., Fort Worth, Tex., restoration, rehabilitation, modernization and modification of government-owned machine tools and capital equipment, NOas 60-0006-c(IP-31-2577-60), $37,948.

Hazeltine Electronics Division, Hazeltine Corp., Little Neck, N. Y., AN/SSQ-23 sonobuoys in accordance with specification MIL-S-19763(AER), NOas 60-0206-f(PD-32-3673-0), $4,282,880.

United Corp., Baltimore, Md., 24 man months of field engineering services for aircraft electrical and electronic equipment, NOas 60-4008-s(MA-60-656-0), $29,596.

Wells-Gardner Co., Chicago, Ill., KY-55/ARW audio decoder and MT-950/ARW mount, 158 and 150 respectively, NOas 60-8008-f(PD-32-3635-0), $76,199.

Vought Aeronautics Division, Chance Vought Aircraft, Inc., Dallas, Tex., materials and services to complete fabrication of three Model KD2U-1 target drone Regulus II fleet training missiles in accordance with detail specification SD-3009-1, with exceptions, NOas 60-8015-c(GM-62-1320-0), $414,423.

AIR FORCE RECRUITERS PUT CESSNA U-3A SUPPORT PROGRAM TO THE TEST. Their work at a small midwestern university done, two Air Force recruiters prepare for take-off—only to find that their battery, beset overnight by sub-zero cold, has gone dead. Course of action: Requisition the nearby Cessna distributor (U-3A supplier) for a new U-3A battery, be airborne by noon. A simple thing. Made possible by a nationwide off-the-shelf support program growing out of Cessna's support of the U-3A's commercial counterpart, Model 310, and conceived by Cessna to do for the Air Force what it would find prohibitive to do itself.

CESSNA

Wichita, Kansas

The Aeronautical Group

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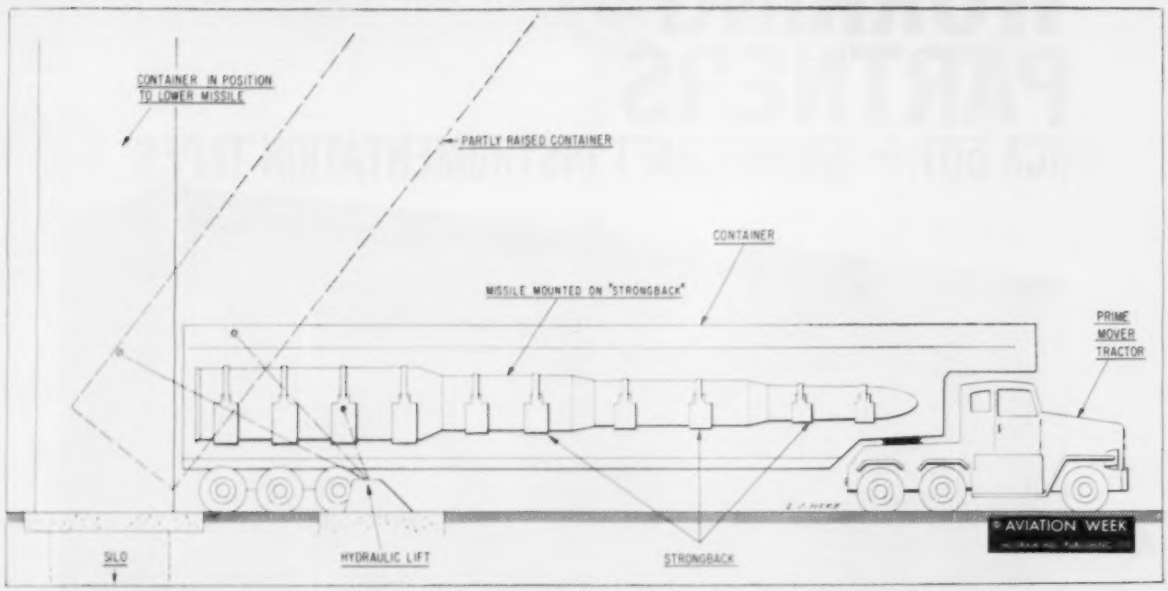

AVIATION WEEK artist's conception shows how Minuteman transporter-erector would position missile in launching silo.

Minuteman Support Refined to Cut Costs

By Richard Sweeney

Ground support systems and components for the Minuteman intercontinental ballistic missile (AW Mar. 7, p. 135) have constantly undergone comprehensive re-evaluation during development.

Reasons for improvement studies are:

• **Eliminating** a job which requires one man 24 hr. per day saves from $350,000 to $500,000 in capital expenditure.

• **Spending** $100,000 to solve a problem to save $1,000 per Minuteman silo would yield a huge saving, considering the total number of silos planned.

Basic Minuteman concept calls for minimum personnel and technical skill to perform operational and maintenance tasks on missiles deployed in remote-area silos.

Parts may be shipped directly from the manufacturer, such as rocket engines or the guidance package, or shipped to the plant of Minuteman assembly and test contractor—Boeing Airplane Co.—where they would be incorporated into a subsystem or system, then sent on to the assembly center.

Transporter-erector designers faced some specific problems which required continued study:

• **States** where Minuteman either will be deployed or will pass through en route from assembly center to silos have a wide variety of limits on maximum total vehicle weights allowed, allowable weights per axle, and foot print pressures. All these states do have waiver provisions. USAF, through the Department of Defense Military Traffic Management Agency, has talked with State officials and it appears that waivers will be obtainable when needed.

• **Transporter-erector** will have to use standard off-the-shelf components, yet still meet highway weight limits. This imposes a weight control as strict as that for aircraft.

The designers produced a missile-transporter-erector combination which falls generally into the middle of the weight spectrum of the various states limits, with waivers.

High shock sensitivity of Minuteman's solid propellant is accommodated in the suspension and mounting of the container's elements. The missile will ride in a carrier which is an integral part of the container, with shock mounting used between the missile and carrier and the carrier and container. Minuteman is restrained longitudinally in the carrier as well as vertically. Special shock provisions are made between the container and its rear bogie. The multiple suspension spreads loads into three points.

General Motors and Cessna, two transporter-erector subcontractors, designed for Minuteman's weight distribution which results from variations in first, second and third stage engines. However, the vehicle accommodates the missile's total weight and its distribution so that failure of any single element in the suspension system would not necessarily cripple the vehicle. Because of the strict weight control, there is no overdesign to compensate for partial disability of the vehicle.

Roads to silos which the transporter-erector will traverse will vary considerably. Vehicle is designed to move at a fair speed over reasonably good gravel roads. Depending on soil and weather, it may even be able to go directly from highway to silo, across deserts and cow pastures.

The transporter-erector is a self-contained unit, with the prime mover-container combined. The vehicle incorporates all auxiliary power required for handling the entire missile in transit and at the silo. Artificial temperature and humidity environment for the solid-propellant rockets is provided inside the container. Electrical and hydraulic power to erect the container to the vertical, then lower the missile into its silo with the container's integral hoist also is provided.

Erection process calls for detaching the container's rear bogie, then hydraulically raising the container to the vertical. Concrete pads on which the hydraulic erecting-rams rest are very accurately located, and serve to align the container in relation to the silo.

Vertical and longitudinal restraints which hold the missile on the carrier are released prior to lowering the missile. The container lowers the missile into the silo, keeping it clear or walls, and accurately positions Minuteman on

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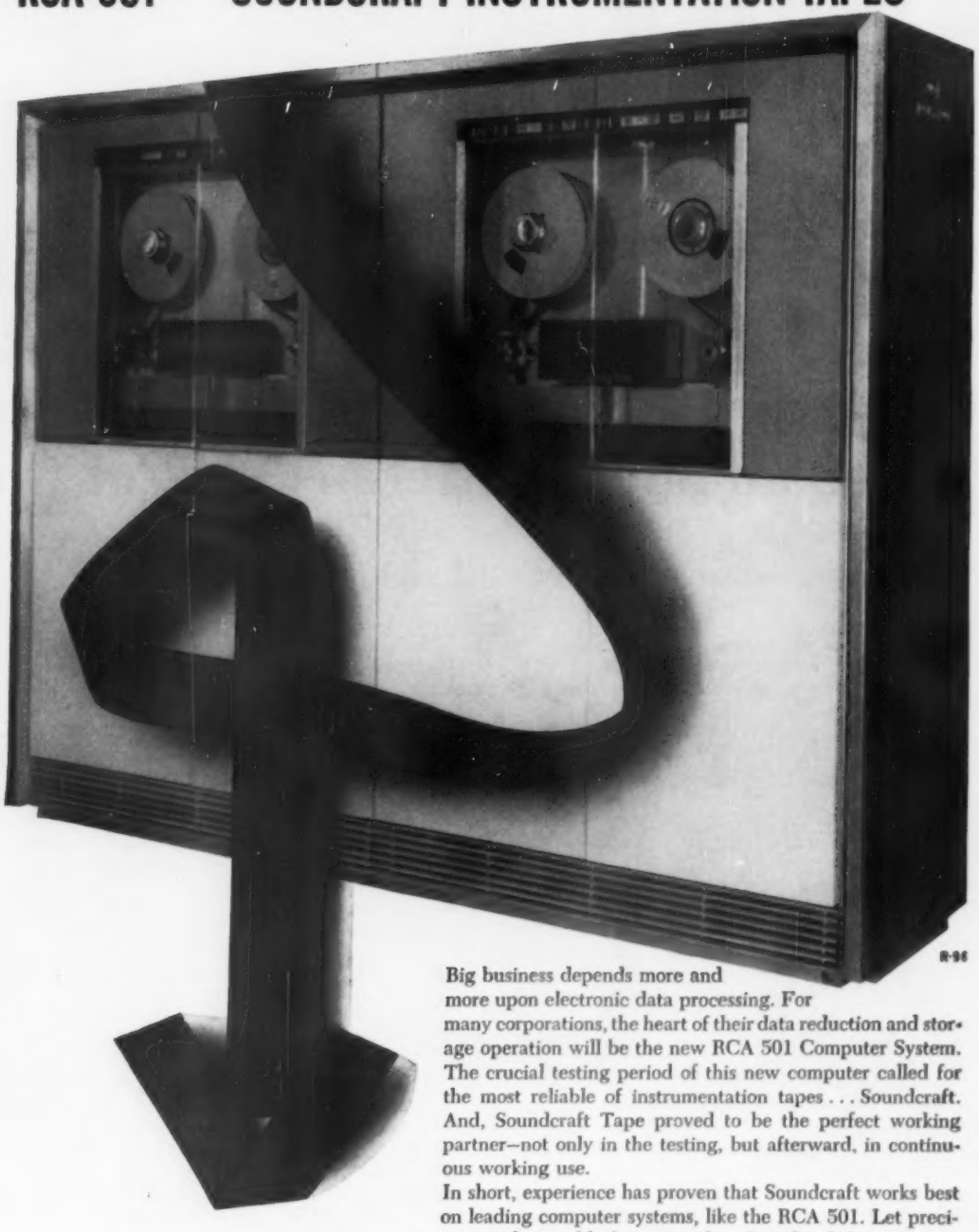
RCA 501 — SOUNDCRAFT INSTRUMENTATION TAPES



R-96

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the missile support structure above the base of the silo.

A driver and driver-helper make up transporter-erector crew. This crew is supplemented by a team of four men at the silo. The six-man group does all the work necessary to prepare the missile and put it into the ready condition (providing no major malfunctions occur) before they leave the silo.

Major dimensions of the Minuteman silo are well-defined now, following the tests at Edwards AFB, in which scale models, then full size missile models were fired successfully from simple steel tube configuration, with a blast deflector at the bottom. The fifth full-scale firing in these tests successfully used a prototype control system and autopilot guidance. It also was the first launch in which the rocket nozzles were swiveled. First stage engines only were used, partly loaded to give three seconds burning time, accelerating the missile to about 3g. A nylon tether restrained the missile, prevented it from falling back into the silo.

Silo interior details have not yet been settled. The placement and design of platforms for missile checkout and maintenance along the sidewall is one example.

Another problem getting attention is a rapidly moving silo lid which would withstand a near-miss blast, then move away fast for Minuteman launch. The door also would have to withstand a negative pressure of significant magnitude which immediately would follow the blast.

Electronic Gear

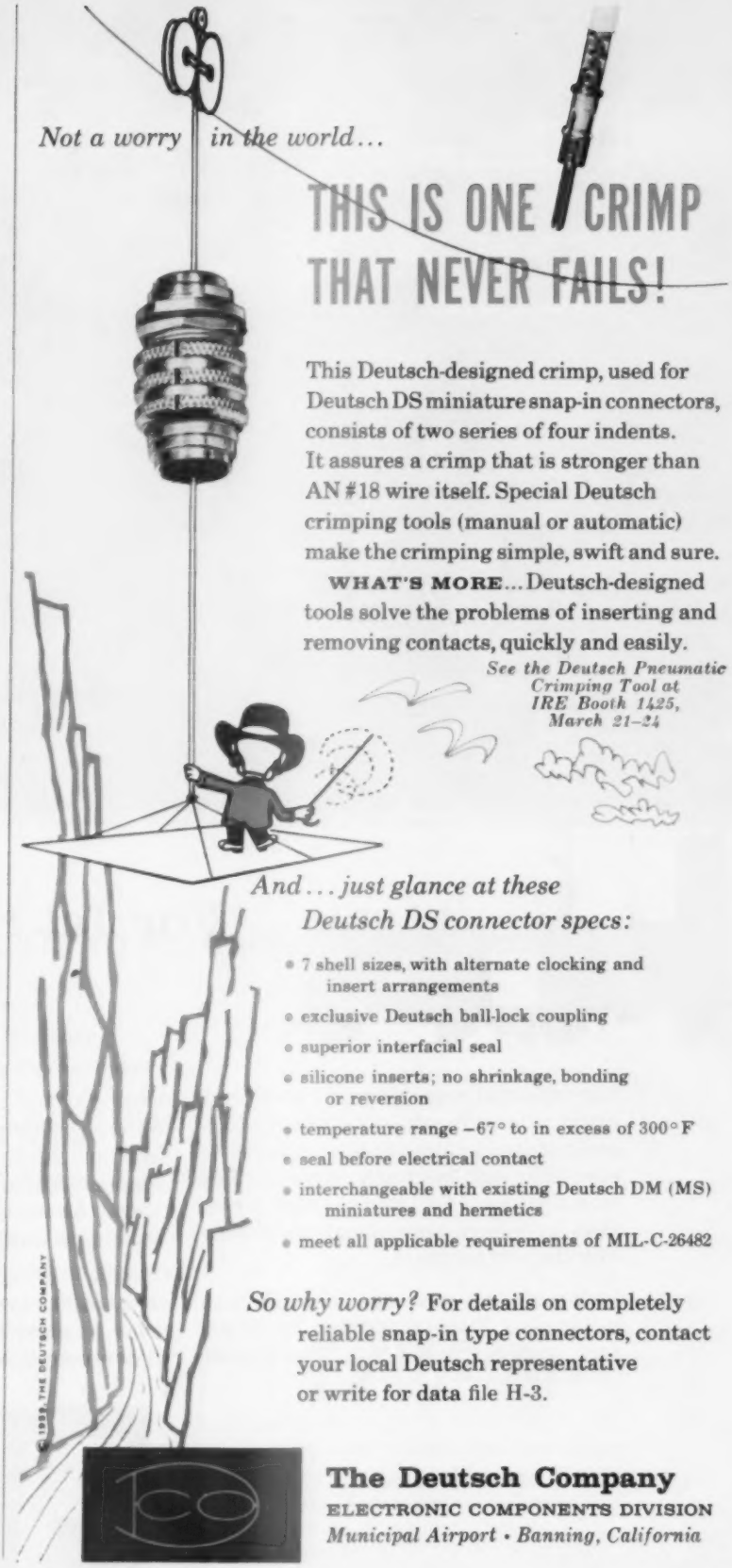
Minuteman electronic ground support equipment is designed to the same general criteria and on the same philosophy as other elements of the weapon system. In view of the large number of missiles involved in the Minuteman program, seeking the most economical, reliable and secure approach for deployment and support generates a very complex design process.

Every technique or capability included in the electronics has to pay for itself in survival of a missile during attack and launch for retaliation.

Operational readiness condition of Minuteman in the silo will be displayed in the launch control center by go, no-go lights only. Lights will be activated by the sequencer-monitor part of the missile checkout-launch control equipment.

A sequencer-monitor constantly checks enough of the missile's key systems to establish existence of a major fault, one which would prevent a successful launch. Sequencer-monitor readout provides no specific fault information in the launch control center.

Philosophy of this operation is based on missile readiness decisions being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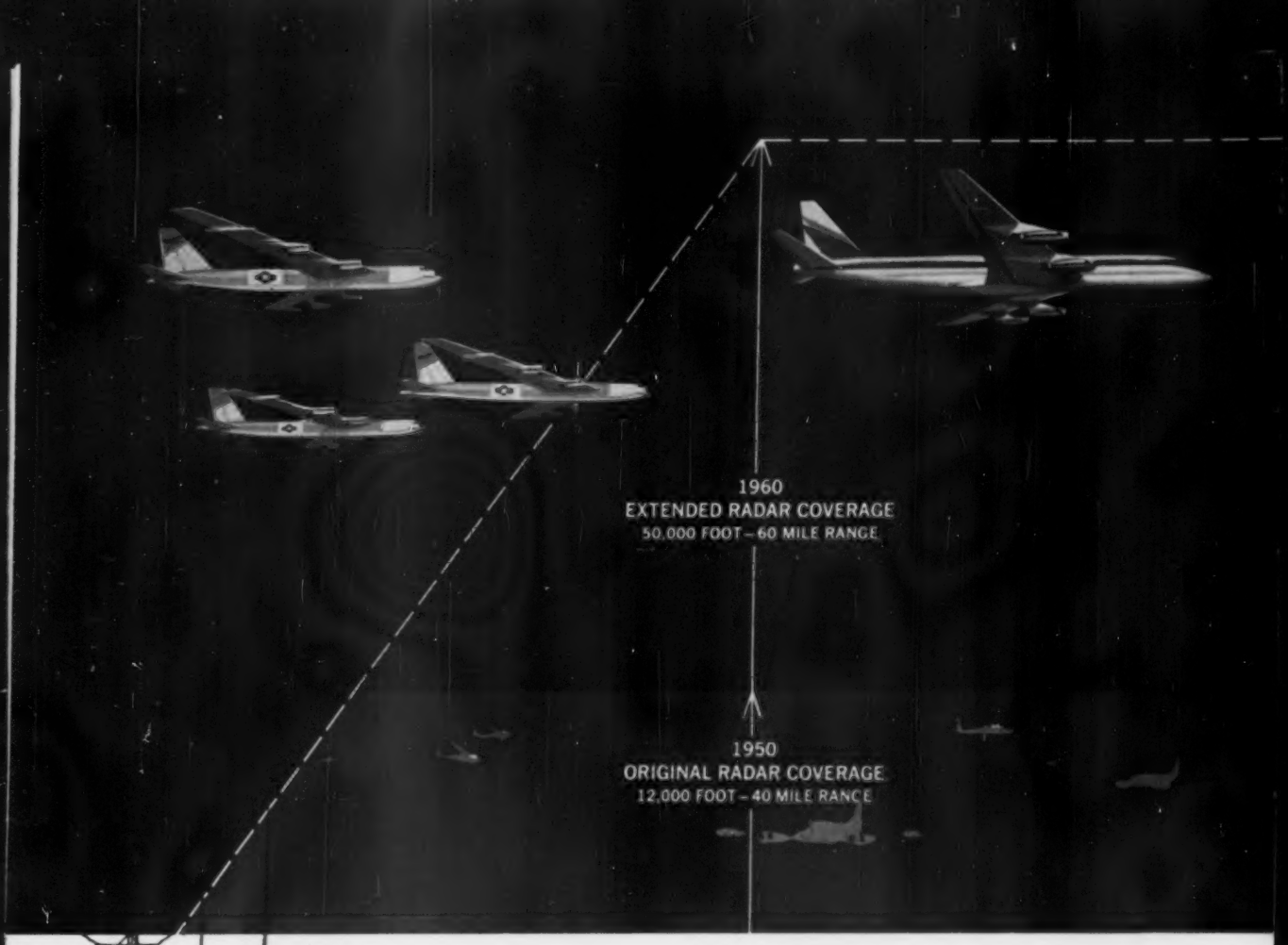

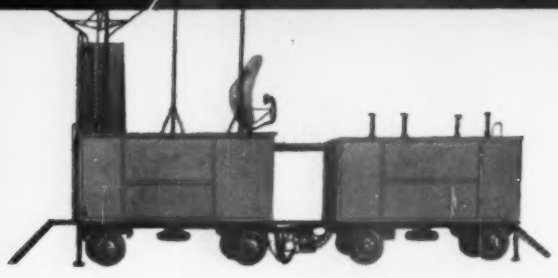

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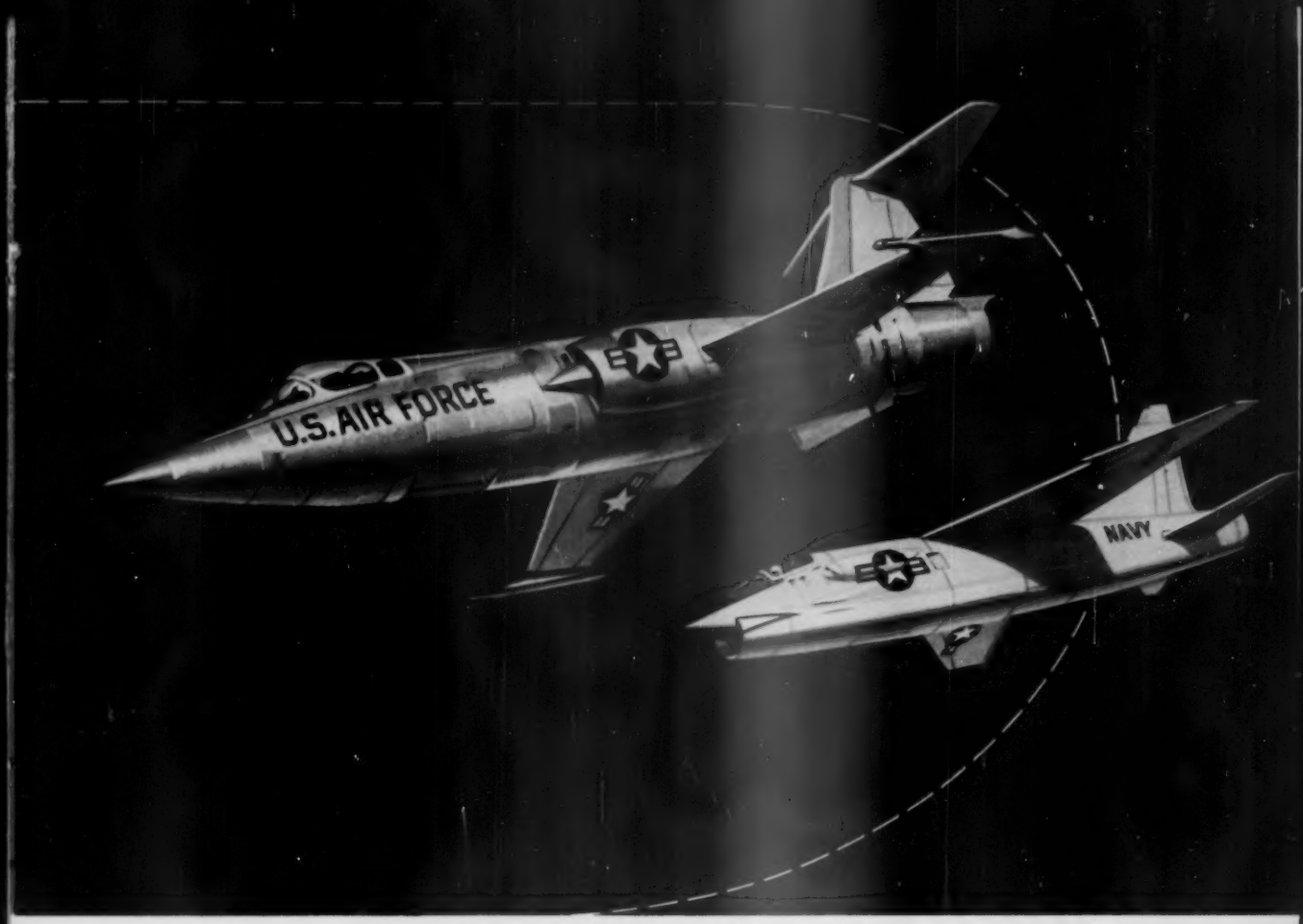

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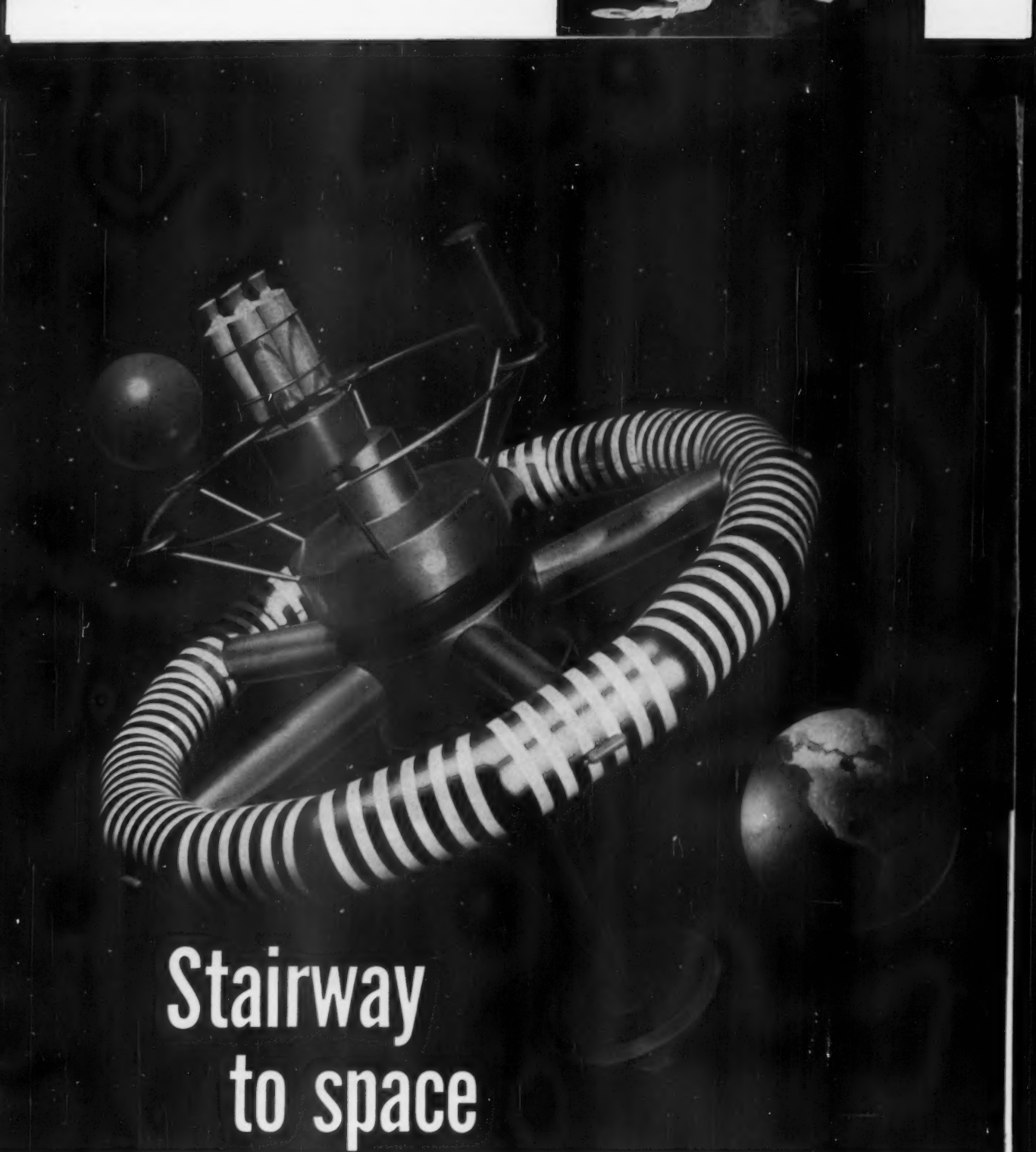

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LOCKHEED MISSILES & SPACE DIVISION

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made by the sequencer-monitor, which gets its data from a number of discrete pieces of information in an instantaneous and constant closed loop operation. This is in contrast to past missile checkout systems wherein missile parameters are measured and fed into a computer where they are compared with established limits, then displayed by a console in their proper position in the operational sequence, after which human judgment decides what action to take.

At the same time the go, no-go light would be showing in the launch control center, a gross category of the fault would be displayed on a readout at the missile site rather than at the launch control center. This readout tells maintenance personnel if they must replace a part in guidance, flight control, hydraulic or electrical systems, but will not pinpoint the fault below the general system level.

When the no-go signal appears in the launch control center, one maintenance man goes to the silo to read the fault category, then calls back what type maintenance gear should be taken to the site, or whether the whole missile needs replacement.

Cost calculations preceding adoption of the go, no-go light only on the launch control center panel, while system fault readout is located at silo, were predicated on a very high missile reliability rating. The concept is feasible only if this level of Minuteman reliability is achieved.

If missile reliability had been calculated at less, then silo panel readout data would have been transmitted to the launch control center from each silo. Since burying cables between launch control center and silo is one of the highest costs for early Minuteman installations, a wrong basic facilities decision in this area could increase system cost by a factor of 10 or more.

Maintenance Planning

Logistics and maintenance designers now are trying to decide what type of maintenance packages should be designed for use in the deployed areas. Current thinking favors a van kit, similar to a telephone company truck.

The van would contain checkout equipment to analyze the faulty system down to the drawer level, drawer being Minuteman equivalent of black box plug-in module technique in past systems. Some vans may be equipped to check out and service specific systems and to stock spares.

Minuteman concept has the drawer replacement as the lowest level of work to be done on the missile in the silo. This requires less technical skill for field maintenance men, but stable personalities will be required. There also is a weight limit on what one man adequately can handle in entering the silo,

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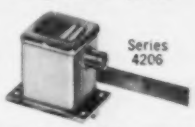

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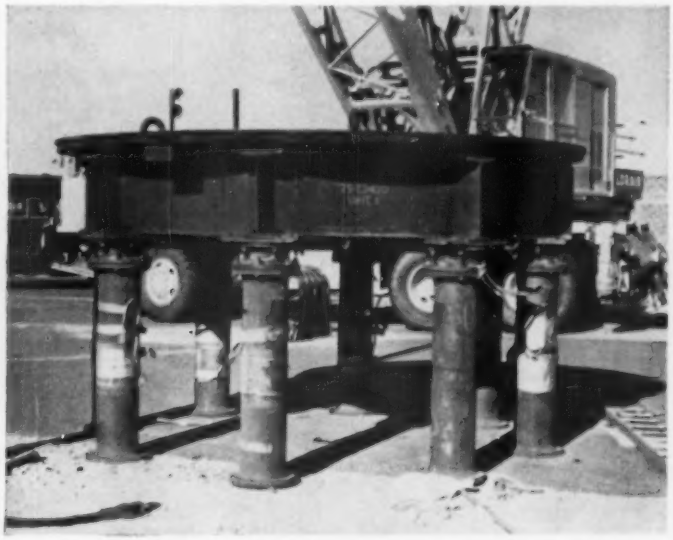
gaining access to the missile, making the change and getting back out again safely. Current thinking is that although electronic components and systems will operate constantly in Minuteman, air conditioning for the solid-propellant rocket engine environment will cool the entire missile/silo combination adequately.

Communications between launch control centers and silos will use standard telephone wire techniques in early installations. However, various radio communication techniques are under study, to simplify communications, increase the reliability and security, and lower cost.

A system which may fit this requirement is an earth-current communications scheme under study by Space Electronics Corp., Glendale, Calif., which uses earth's conductivity to carry electromagnetic radiation from launch control center to silo (AW May 18, '59, p. 26).

Individual electronic components, such as transistors and diodes, will undergo extensive tests prior to incorporation in Minuteman system. It is planned to gather sufficient data on individual components to eliminate the confidence factor from the reliability specifications. In some cases, manufacturers are having to revise production techniques to qualify their products for the program.

Intent is to test individual types of components so that, when they are incorporated into a large Minuteman system or subsystem, ratings will be so well-known that a valid over-all reliability rating can be placed on the assembly.



SECTION of one of the silo liners used during Minuteman launching tests is shown at left. Liners of several diameters have been tested to determine the smallest diameter feasible for operational silos. One of the stands used at the bottom of the silos is at right.

Air Force Studies Minuteman Silo Needs

By J. S. Butz, Jr.

Edwards AFB, Calif.—Air Force-Boeing tests conducted here thus far have effectively demonstrated that the Minuteman solid-propellant ICBM can be launched successfully from underground, and the silo launcher development program for the missile has shifted to a search for the most economical silo diameter and construction materials.

Silo diameter has a critical influence on silo construction costs. It is estimated that a reduction of one foot in permissible silo diameter would result in a large dollar savings in any nationwide construction program. The present silo launch project is balancing construction economy against possible missile damage during firing from heating and pressure loads which increase rapidly as the silo diameter is reduced. A major phase of this project's work is to choose the most economical construction materials that also will provide the required blast protection for the ICBM and will not spall or disintegrate during a silo firing.

Full-scale battleship models of the Minuteman have been fired five times from two test silos in the hills above Rogers Dry Lake after more than 200 small-scale tests defined the general configuration of the operational silo (AW Dec. 7, p. 57). Subsequent firings will be made with dynamically similar models to check the design estimate that missile vibration will not have any noticeable effect on a silo launch.

First-stage engines used during the full-scale firings had a burning time of only 3 sec. and propelled the test missile 150 to 200 ft. above the silo with an acceleration of about 2g. Nylon ropes in a slingshot arrangement were used to put a side force on the missile at an altitude of about 150 ft. to prevent it from falling back into the silo.

Propellant gases from the first stage engine are exhausted along with the missile out of the top of the silo after being rerouted by simple curved deflector plates in the silo base. Clearance of three to five feet will be left between the side of the silo and the missile to allow passage of these rocket exhaust gases. Heat transfer and acoustical and pressure loads during a launch from this confined space have been found to have no detrimental effect on a missile with the stiffness of the Minuteman.

Air Force also is assessing the ability of liquid-fueled ICBMs to withstand launch from the bottom of a silo so that the elevator systems in their current silo designs can be eliminated, and the missiles will not have to be exposed at the ground surface prior to launch. There is some controversy as to whether these thin-skinned missiles can be employed in this manner since they are affected by vibrations to a much greater degree than solid-fuel rockets, and their initial low acceleration would keep them in the silo three to four times as long as

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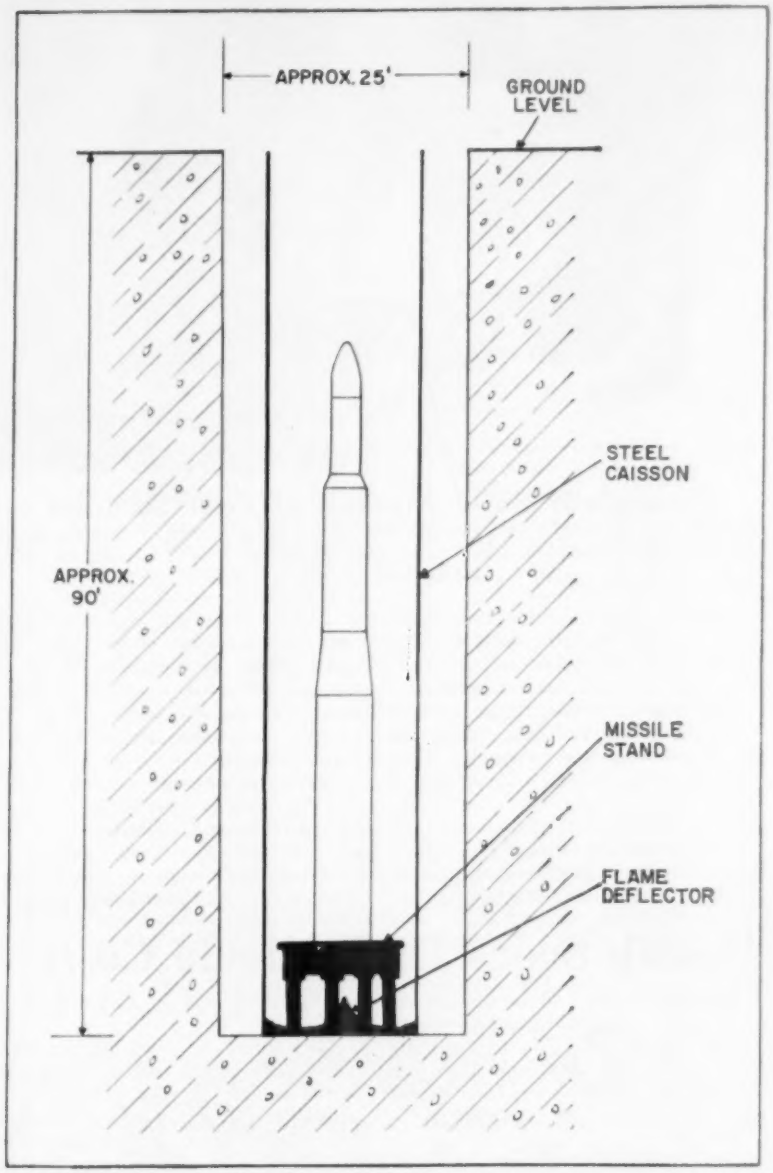
the Minuteman. The two silos at Edwards are approximately 90 ft. deep and 25 ft. in diameter and could be used for launch tests of full-scale Titan or Atlas models with short burning time engines.

Silo development program for Minuteman has been primarily an empirical study to determine the effects of:

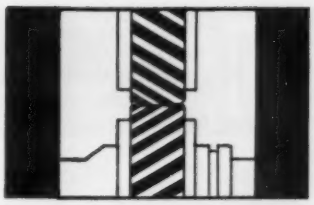
- **Missile movement** out of the silo (emergence).
- **Flame deflector shape.**
- **Silo depth and diameter** variations.
- **Changing missile angle** of attack.
- **Off-center missile** positioning within the silo.
- **Canted nozzles.**
- **Liner material changes.**

First tests were begun by the Air Force in April, 1958, with a 12 in. dia., 4,000-lb.-thrust engine in a steel tube. More than 200 tests were made with models of less than 10% scale to obtain a broad reading on the effect of the design parameters listed above. For example 45 different flame deflectors were tested.

A number of questions developed during these small scale tests could not be answered properly without larger scale tests, so a one-third scale Minuteman and silo were designed. The first test with this rig was accomplished in February, 1959. Boeing took over the



SCHEMATIC of the full-scale battleship model of the Minuteman intercontinental ballistic missile in one of two test silos at Edwards AFB is shown above. Silos are large enough to allow testing of Atlas and Titan models.



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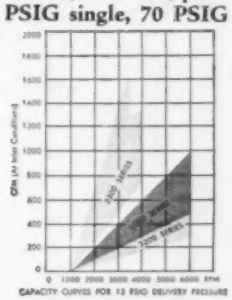

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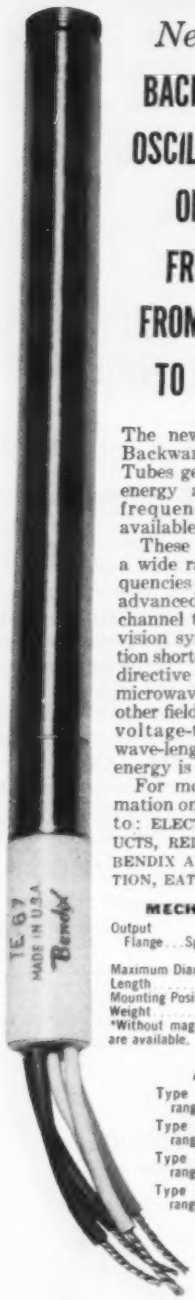

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Length	8"
Mounting Position	Any
Weight	5 oz.*

*Without magnet (tube only). Magnets are available.

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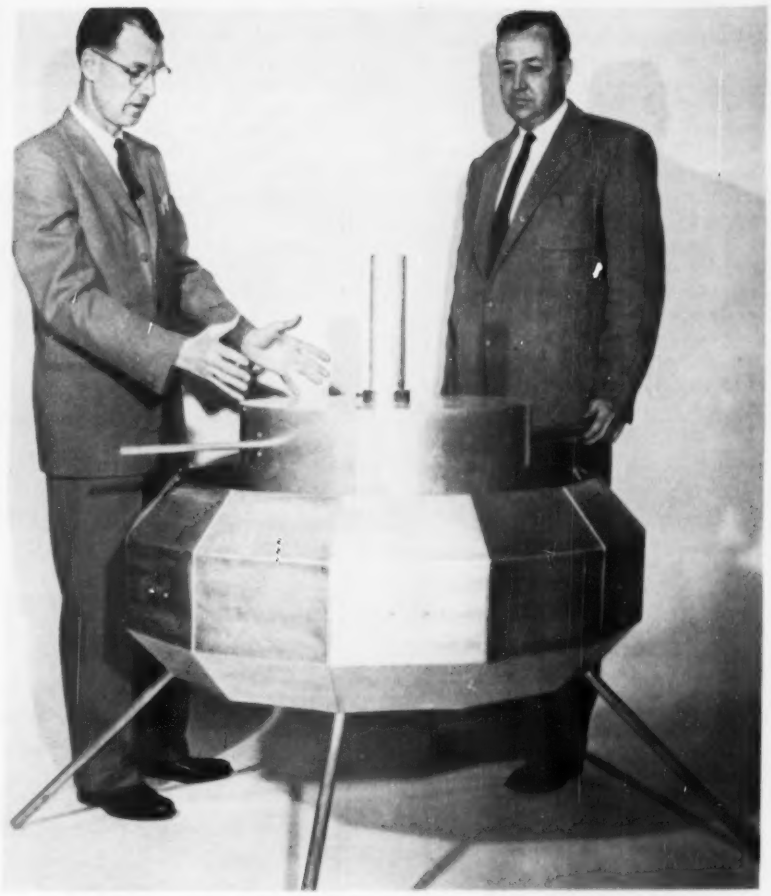


Canadians Build Mockup of First Satellite

Canada's first space satellite will be made of aluminum and glass fiber. The 200-lb. device will carry banks of solar cells around its 42-in.-dia. midsection. Thor-Delta vehicle is scheduled to launch the satellite into a polar orbit in 1961 (AW Feb. 29, p. 26).

primary responsibility for these tests from the Air Force in May, 1959, and 13 of the 25 scheduled one-third scale silo tests have now been completed.

Full-scale silo testing began last September in the two silos here. Steel liners of various diameters are placed inside these holes to simulate several sizes of operational silos. The test missiles are placed on heavy steel stands 6 to 10 ft. high at the bottom of these liners. Steel deflector plates of several shapes are available to fit around the steel stands.

A major problem now under consideration is the design of a simple, fast-opening, blast-proof door for the top of the silo. One simple solution under study is to use the pressure from the rocket exhaust gases to move the heavy door. Counterweights for the door could set the internal pressure needed to open it. This would have to be balanced against the amount of negative pressure expected on the surface after a near miss by a large yield warhead, which could possibly open the door before firing.

British Score High Missile Costs

London—Twelve-fold increases in the estimated costs of missiles were revealed in the House of Commons recently accompanied by allegations that misleading reports had been made by the now defunct Ministry of Supply to the Treasury.

Sir Edmund Compton in his report on the civil appropriation accounts for 1958-59 revealed that Britain's first generation of missiles—estimated to cost $22.4 million—had in fact cost $308 million.

The report is a far-ranging commentary on government spending presented annually by the controller and auditor general, a civil servant who controls issue of money to government departments and audits departmental accounts.

The actual missiles were referred to only as Type A, B and C, but these

have been identified as Seaslug, Thunderbird and Firestreak, respectively.

Most serious example of costs exceeding estimates occurs with the Seaslug, which was Britain's first guided missile. Contract for its development was placed in February, 1949, the cost being estimated by the Ministry of Supply at between $2.8 million and $4.2 million. This missile, which has still not entered service, has now cost $112 million.

The English Electric Thunderbird estimated to cost $7 million when the contract was placed in 1950 has since cost $75.6 million and expenditure on the de Havilland Firestreak put at $11.2 million when the contract was placed in 1952 has since reached $120 million.

General industry reaction indicated that the total costs of all the missiles mentioned was not excessive and that the original estimates were totally unrealistic. "Who ever thought you could develop a ship-to-air missile from scratch for $2.8 million?" was typical of the comments from several sources.

In the case of Seaslug, the prime contractor appointed by the ministry—Armstrong Whitworth Aircraft, Ltd.—was a member of the Hawker Siddeley Group. The Treasury was informed that the whole resources of this group would be behind the development, and annual development contracts followed. The contract did not provide a firm specification.

The subcontractors included Sperry (control), General Electric (guidance) and Imperial Chemical Industries (propulsion). According to the report, development got considerably behind schedule and in 1955 the Ministry became critical of the group's "failure to bring its resources into action, and expressed dissatisfaction with the contractor's failure to provide competent leadership and to coordinate effectively the work of the other contractors." In 1956, the report reveals, the Ministry itself assumed responsibility for the coordination of the project and reduced as a direct penalty the profit allowed the group by $106,000.

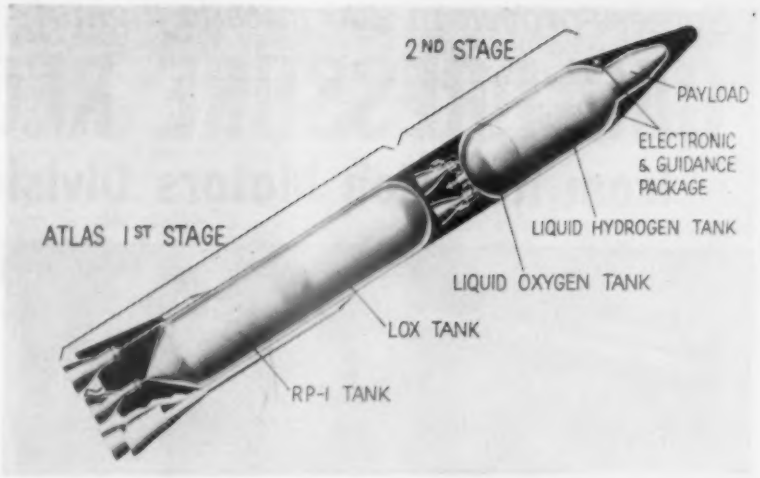
Delivery of Seaslug, the report notes, is now expected to begin five years later than originally called for in the staff requirement.

Two particular sources of delay, says the report, were the need to change from one type of rocket motor to another, and the failure of the group to provide adequate leadership.

But the report adds that to a large extent, "the delays and the related increases in cost were a reflection of the inherent impossibility of making reliable estimates at the outset . . . of the amount of testing involved." The report then states that "the initial estimate . . . of 1-1.5 million pounds sterling ($2.8-4.2 million) represented estimated payments to the main contractor only," and available records seemed to indicate that it related to the development period up to the time when intensive firing trials would start, although this was not made clear to the Treasury.

The report states that five years after the development contract for Thunderbird had been placed, it was decided to limit production of the original version of the weapon pending development of a more advanced version, the original weapon not having met the full operational requirement.

A development contract for the ad-



Atlas-Centaur Cutaway

First cutaway drawing of Atlas-Centaur space booster shows large volume required for liquid hydrogen tank compared with that of liquid oxygen tank in upper stage. Both USAF and National Aeronautics and Space Administration will use Centaur. Upper stage, built by Convair, is powered by Pratt & Whitney XLR-115 engine. It also will be used in Saturn.

British Consider Skybolt and Polaris

Britain is considering both the Douglas Skybolt and Lockheed Polaris missiles, Minister of Defense Harold Watkinson said at the opening of a highly critical parliamentary debate on the Defense White Paper.

A question mark still hangs over the future of Blue Streak. The British V-bomber force, according to Watkinson, could "fulfill its planned tasks until beyond the mid-1960s" when armed with the Blue Steel stand-off bomb. (However, George Wigg, an opposition speaker, later said that "we have no Mk. II Vulcans and no Mk. II Victors and we have no stand-off weapons.")

Blue Steel is expected to become obsolete by the late 1960s because of its vulnerability to surface-to-air missiles, continued the minister, and development of Skybolt is being closely followed by the RAF, although he emphasized that Skybolt was still in the experimental stage. Also, "the Royal Navy has complete links with the U. S. Polaris development program," he said.

The minister announced that the British army will have Honest John surface-to-surface missiles. (Reports indicate that one unit is being equipped initially, and the missiles are expected within three months.) Production status of Blue Steel was not mentioned.

First mention of orders for the Vickers VC.10 was made during the debate, coupled with reference to the de Havilland Comet 4 as a possible replacement for the Comet 2s already in service with the RAF, which are "coming to the end of their useful life." A further order for the Armstrong Whitworth 660 Argosy transport was also indicated.

There was much criticism of Blue Streak. Typical comments by members of Parliament were: "it has always been clear to me that a fixed site missile is an invitation and not a deterrent," and "the ill-fated Blue Streak . . . most unlikely ever to go into production."

The Ministry was accused of vacillation. "In the White Paper," said Nigel Birch, a Tory member, "apart from anything else, there are projects for 11 different types of missiles and 12 different types of airplanes. If these projects are carried through, it will be impossible to have significant quantities of any of the weapons. We therefore run the risk of . . . being weak everywhere and effective nowhere."

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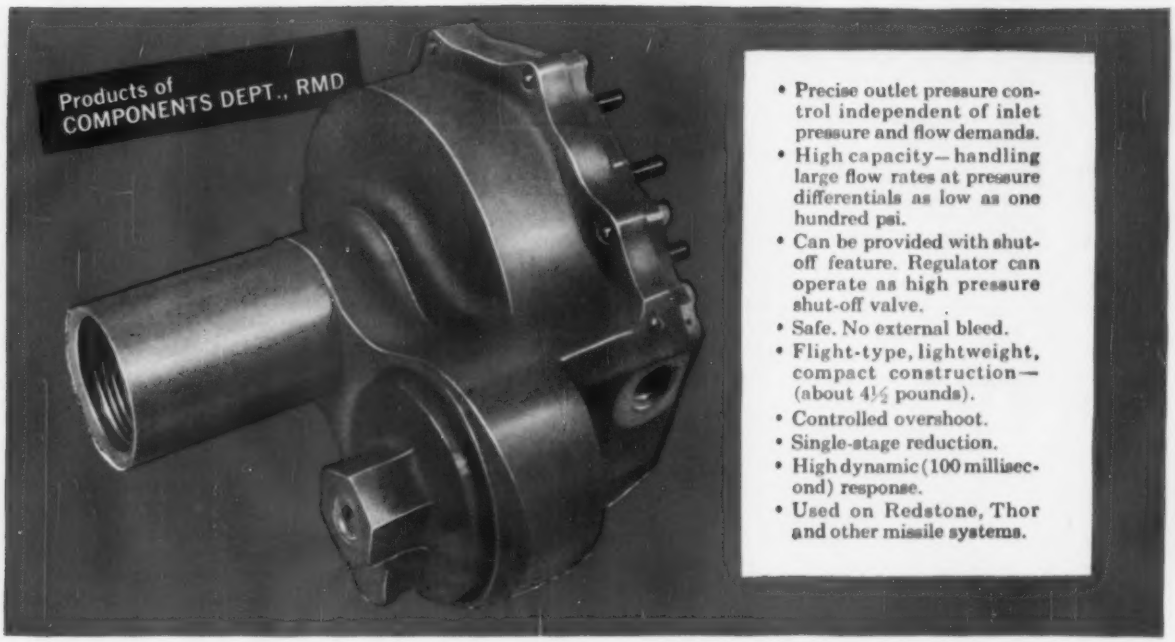
from Reaction Motors Division of THIOKOL



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Modifications of foregoing characteristics can be obtained, or special designs developed to meet your specifications.

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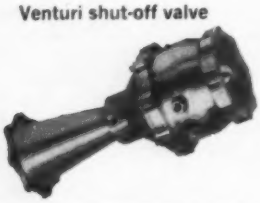

Explosive actuated on-off valve

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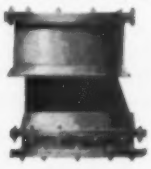
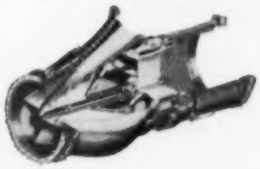


Disconnect-Check valve



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vanced version was placed in March, 1956, but, following an offer by English Electric to assist in the funding of the original version, development of both versions proceeded.

The English Electric offer was conditioned by requirements that an Army order be placed for the original version and this order was in fact placed in December, 1956. English Electric was also to be reimbursed if orders for either version were subsequently canceled, and following cancellations of the Air Ministry order the company received a reimbursement payment of approximately $600,000. "I recently asked the Ministry of Aviation," Sir Edmund reports, "whether Treasury approval had been sought for this reimbursement . . ."

The Ministry had informed Sir Edmund that the original estimate made no provision for manufacturing and evaluation trials. "No firm prices for a production missile have yet been agreed," the report notes, "but the Ministry's estimated price at November, 1958, was more than double the estimate given the War Office in 1956." Sir Edmund added that he has asked the Ministry the reasons for the substantial increases in estimated development and production costs of Thunderbird.

The Type C missile, generally thought to be the Firestreak air-to-air missile, was awarded to de Havilland which had undertaken the design study. The contract was placed in 1952. De Havilland estimated the cost at $11.2 million spread over five years. Contracts stated that development would be to a specification, but no specification was ever received, says the report.

The Mk.1 version eventually cost $66 million, Mk. II and III were canceled and Mk. IV added another $56 million.

Other expenditures which snowballed included evaluation of a navigational system not identified in the report, and carried out from Boscombe Down. Treasury approved an expenditure of $240,000. Through an "oversight," Sir Edmund stated in the report, the government research establishment at Boscombe Down was not told of the treasury expenditure limitation, and had not been told to record its expenditure on this project. As a result a sum of $840,000 was spent.

Research Probe Fired

Research rocket is fired by Sandia Corp. at Naval Missile Facility, Pt. Arguello, Calif. Shot is first of six in a study whose objectives are to place instrumented payloads at more than 200-mi. altitudes, evaluate performance of instrument packages, to obtain high altitude atmospheric data and to determine ballistic performance of three-stage instrument carrier.

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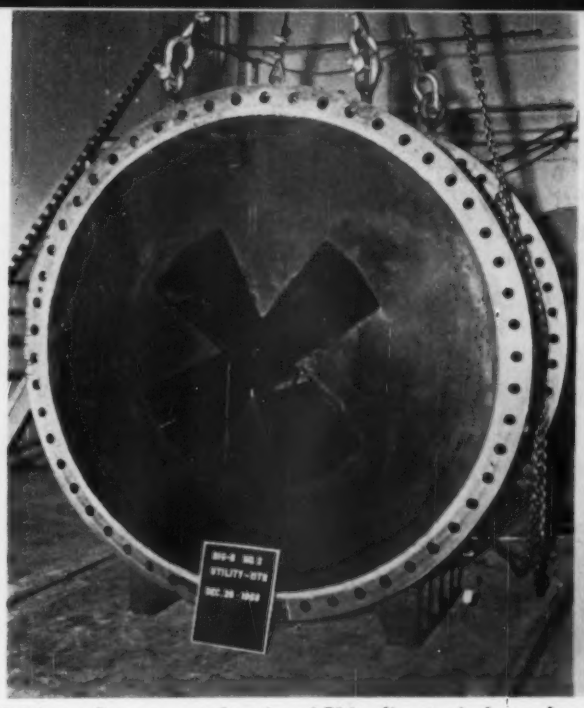
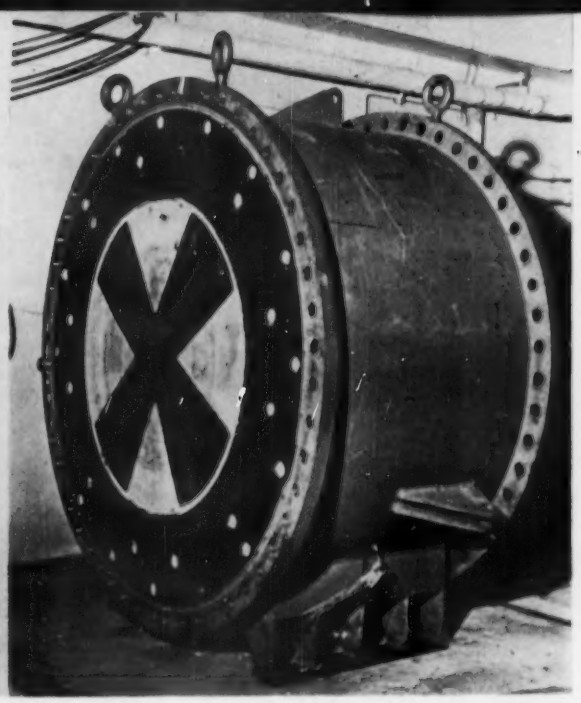
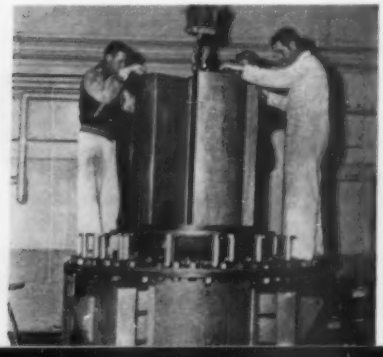




Solid propellant segmented casting of 70-in. diameter is shown above before and after cutback and inhibiting. White areas are freshly exposed patches of propellant where propellant risers have been trimmed off to make surface smooth and level. After risers are trimmed, propellant surface is cut back and machined smooth and then covered with a hydrocarbon sealant and propellant charge inhibitor.

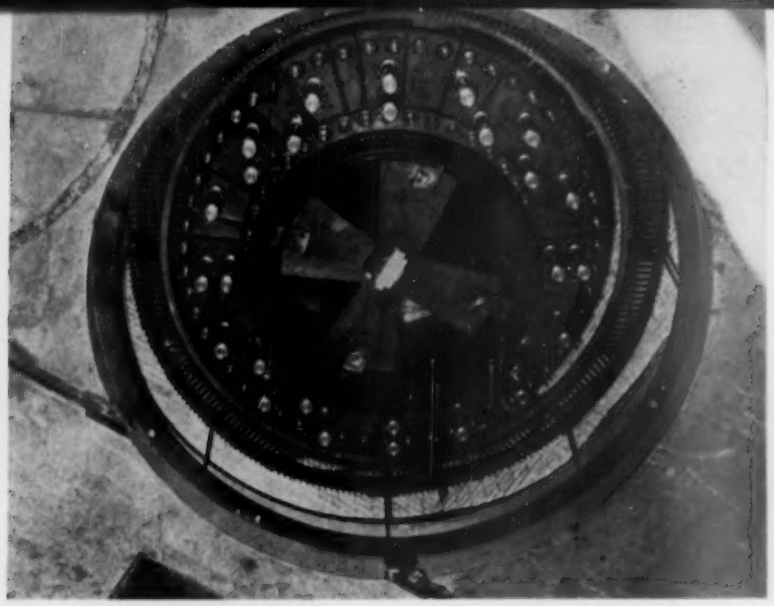
Segmenting Solid Rocket Grains Aids Handling

Interface of segmented 125-lb. scale solid rocket motor is treated to prevent burning between segments (above). Prior to casting, core (below) which determines configuration of propellant's burning surface is lowered into casing.

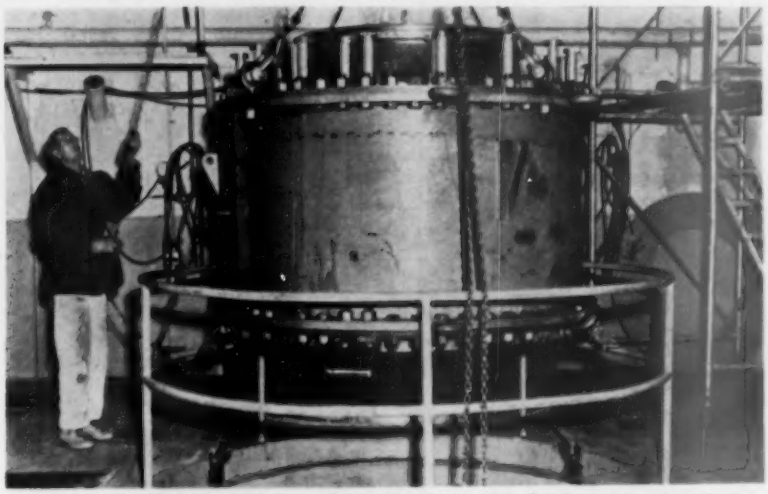


Segmentation, one of the more promising answers to the problem of handling large solid propellant rocket engines (AW Feb. 1, p. 21), already has been proven feasible, according to Thiokol Chemical Corp. engineers at Huntsville, Ala. First photos of a large solid propellant grain segment produced by Thiokol in 1956 demonstrate the practicability of this approach in making solid propellant rocket engines of ICBM dimensions. The segment produced by Thiokol was 70 in. in diameter and used one of the newer types of solid propellant. Going from 70-in. segments to even larger ones for space boosters should prove a relatively simple undertaking, Thiokol says. What is believed to have been the most serious drawback to segmented engines—flame propagation and combustion burning between segments—reportedly has been successfully overcome by use of a hydrocarbon sealant. The sealant which helps hold two adjacent segments together also acts as an inhibitor that prevents combustion from taking place on the segment interfaces.

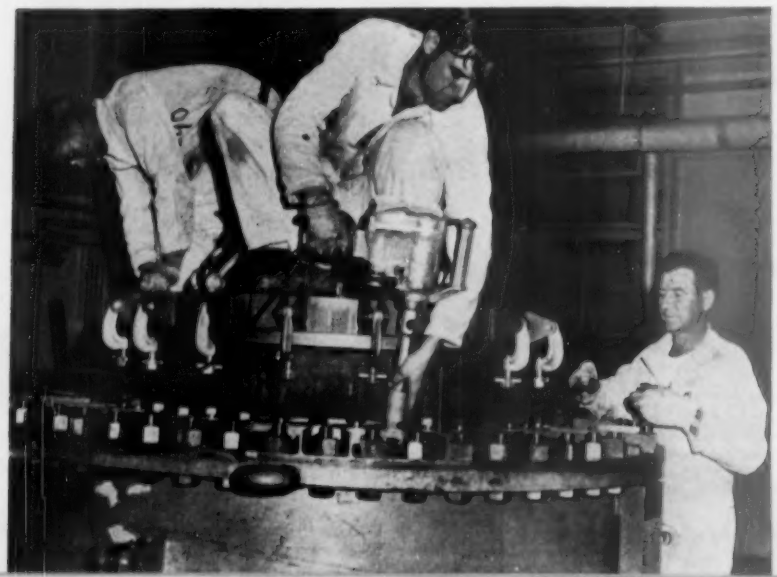
In preparation for application of propellant liner, worker manually degreases 70-in.-diameter casing segment with chlorinated hydrocarbon solvent.



With casting cover and mandrel in place, segmented 70-in.-diameter solid propellant casing, viewed from above, sits in casting and curing pit ready for casting. After casting, heating elements in pit will be turned on to cure propellant.



Using an overhead hoist, workman (above) lowers the completed casting assembly into casting and curing pit where the propellant will be added through the casting cap. Below, technicians tighten casting cap to top of casing segment. In casting solid propellants, the cap holds the excess of propellant which is generally poured to ensure against voids. The excess is cut away flush to the casing after curing is completed.



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PV012	.188	14,500	10,000	4.5	4.45	3.06
PV024	.367	11,600	8,000	6.9	4.53	3.13
PV039	.600	10,000	8,000	10.2	4.33	3.46
PV062	.950	8,900	7,000	14.0	4.44	3.49
PV104	1.600	7,500	5,800	19.0	4.65	3.59
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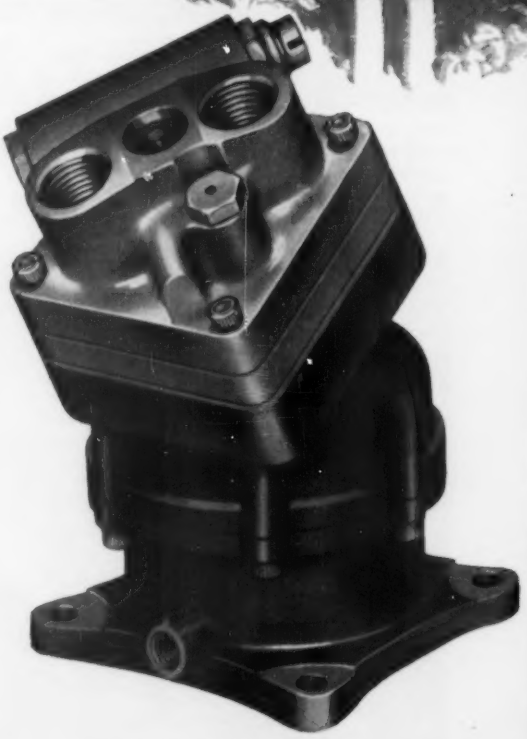
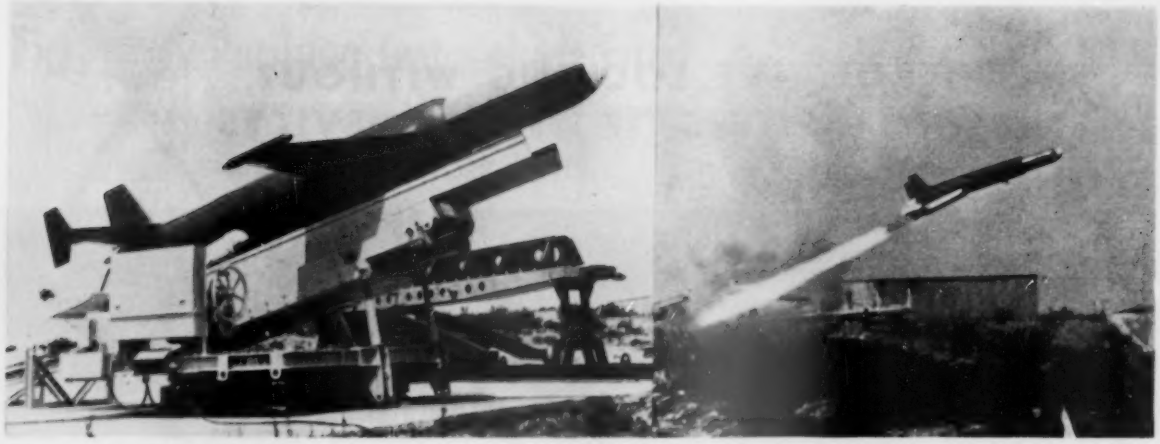


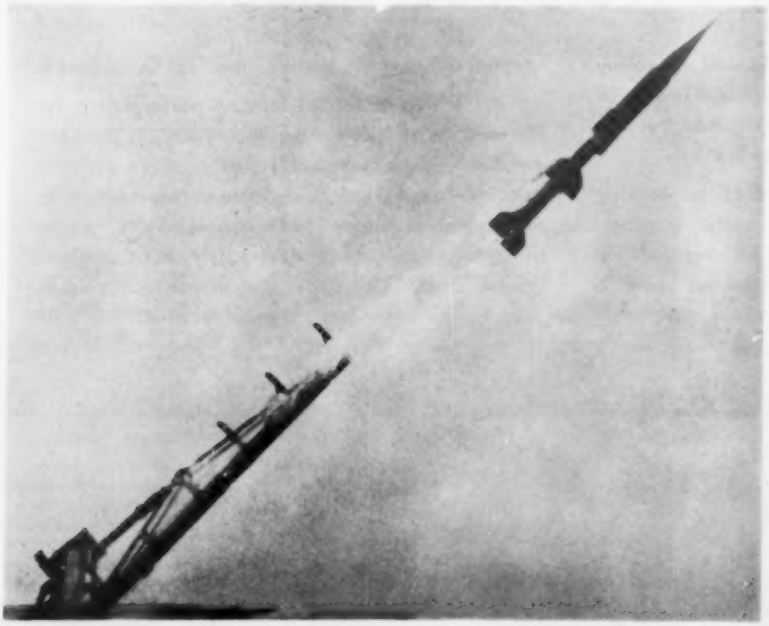
Variable Hydraulic Motors using the Advanced Design Series concept are now under development.



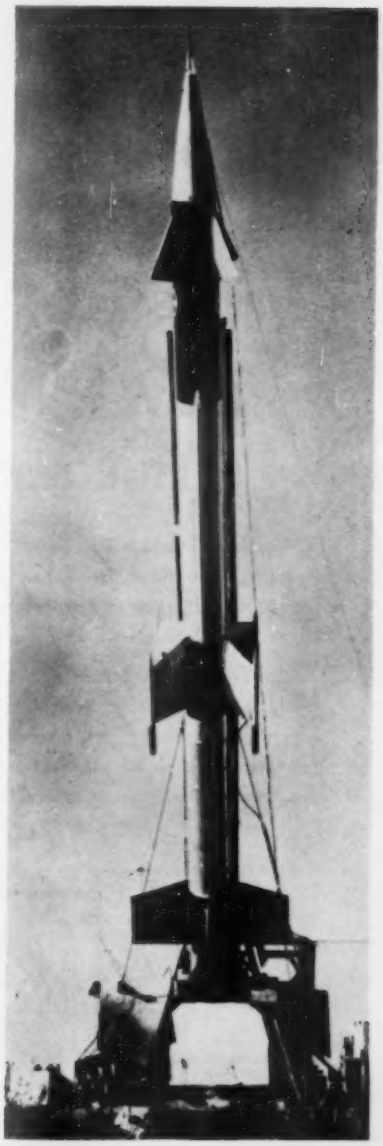
French navy's Malafon short-range anti-submarine missile is shown on launch unit and during firing near Toulon navy base.

French Navy Missiles Start Tests

French navy is concentrating its missile program on two missiles—one a glider type for anti-submarine warfare, the Malafon (above), and a Mach 2 anti-aircraft weapon, the Masurca (below, right). The Malafon is designed for navy escort vessel installation to attack subs at shipboard sonar ranges and will enter service late this year or early 1961. Built by the French company, Latecore, the weapon is launched by a booster which disengages after burnout; missile is guided by ship's sonar computer and, in the target area, a radio command releases a tail parachute. The Malafon then drops a torpedo fitted with an acoustic homing warhead. The Masurca is 19 ft. long with a 4.6 ft. wingspan; cruciform panels can be folded or removed for storing. The missile can deliver a 220 lb. warhead in a 20 mi. range; launch weight is 3,200 lb. and service ceiling is 70,000 ft. Both booster and missile powerplants use solid propellants. The Masurca is radio-guided by shipboard control unit using radar and a computer to track the target and supply guidance data. The French navy claims that the Masurca, operating at low or medium altitudes, is several times more effective than the best known conventional anti-aircraft weapons. Tests on both missiles are continuing at the French navy missile test center at Ile du Levant, near the Toulon navy base.



Masurca missile (on launch stand, right) is fired in test at Ile du Levant test center.



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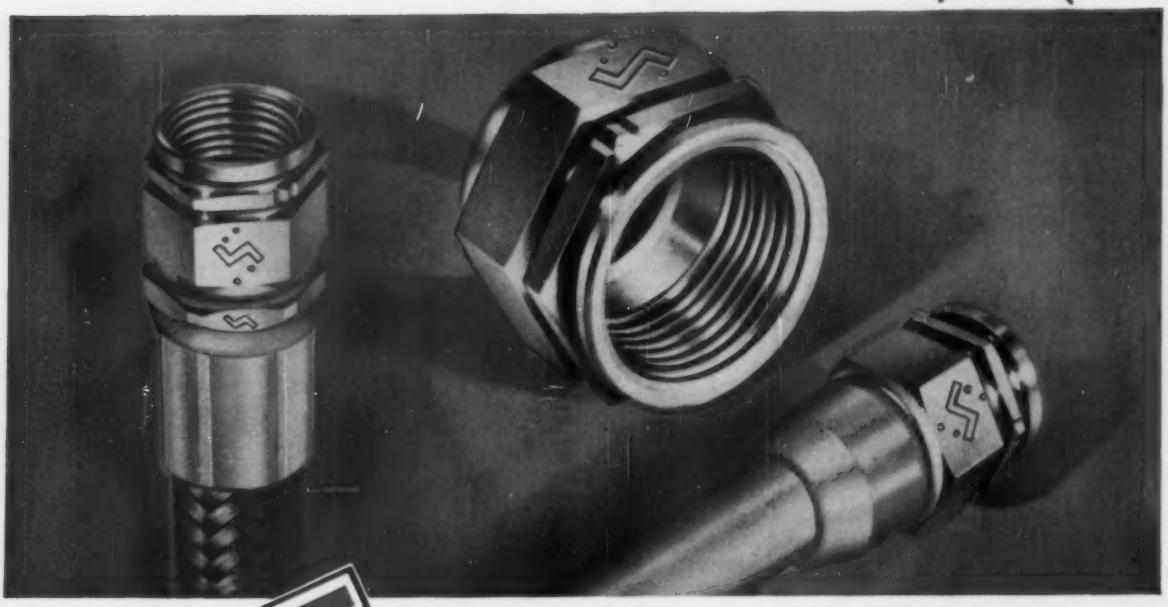

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SF4-0

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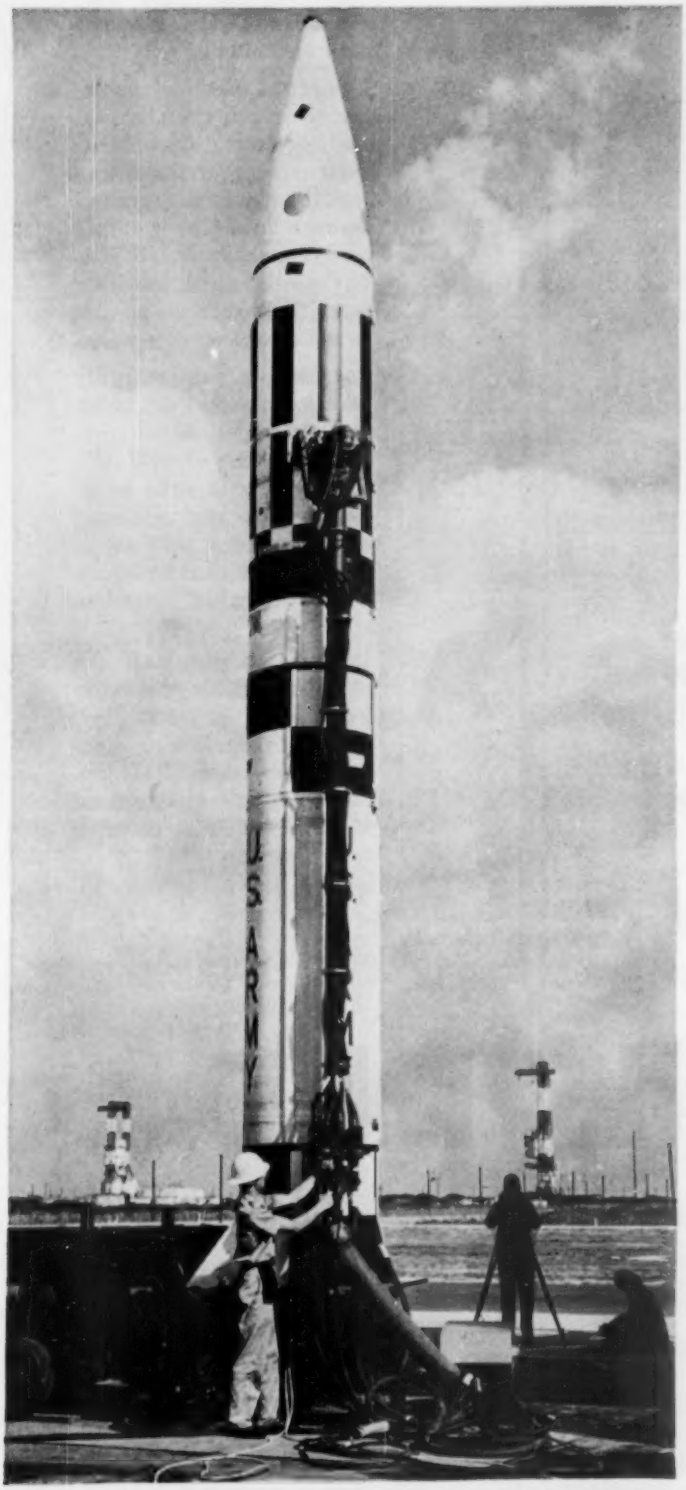
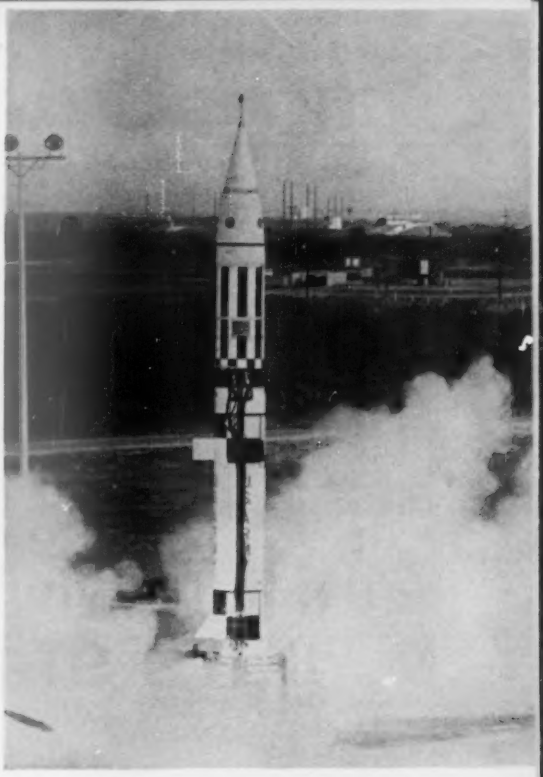
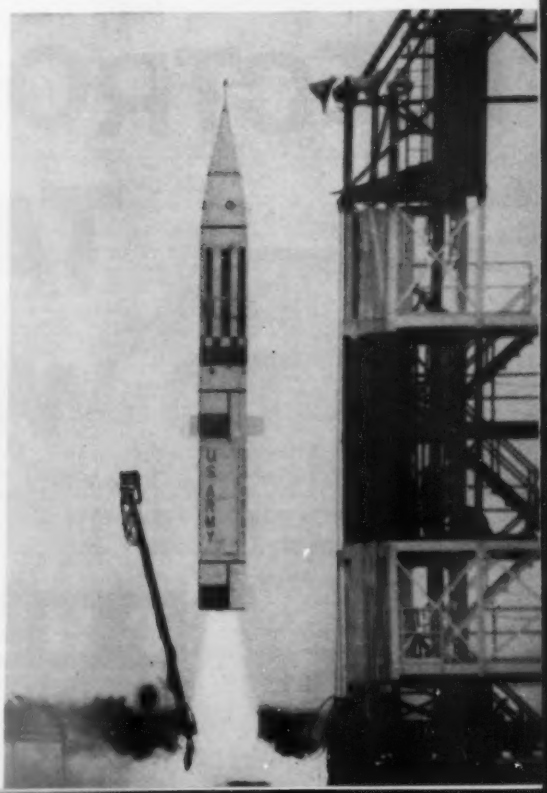
First Army Pershing Test Vehicle Fired



Firing test utilized only first of two Pershing stages. Missile is undergoing avionics check. Probe during actual launch (fitted on nose) is angle of attack indicator.



Army-Martin Pershing solid propellant tactical missile flew about 20 mi. in its initial firing from Cape Canaveral, Fla., (AW Feb. 29, p. 34). Pershing is lighter and smaller than the Redstone it is designed to replace. Test vehicle shown here is 32-ft. long; final Pershing configuration will be similar in size and shape.



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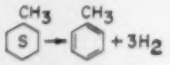
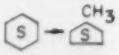
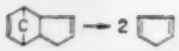
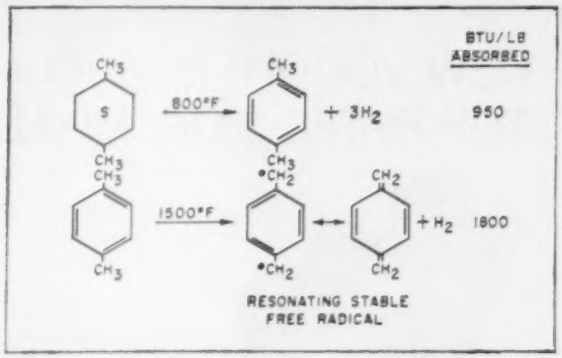
REACTION	EXAMPLE	HEAT SINK TO 800°F BTU/LB
CRACKING	$C_8H_{16} \rightarrow 2\,C_4H_8$	780
DEHYDROGENATION		1500
ISOMERIZATION		645
DEDIMERIZATION		680



CHARTS show five basic types of endothermic reactions an aircraft fuel might undergo at high temperature along with amount of heat each pound of fuel theoretically would absorb for the specific reaction.

Fuel May Cool Manned Flights at Mach 4

By Michael Yaffee

New York—New aviation fuels that absorb large amounts of heat by breaking down in flight to form two or more other fuels may hold the key to the cooling requirements of manned flight at Mach 4.

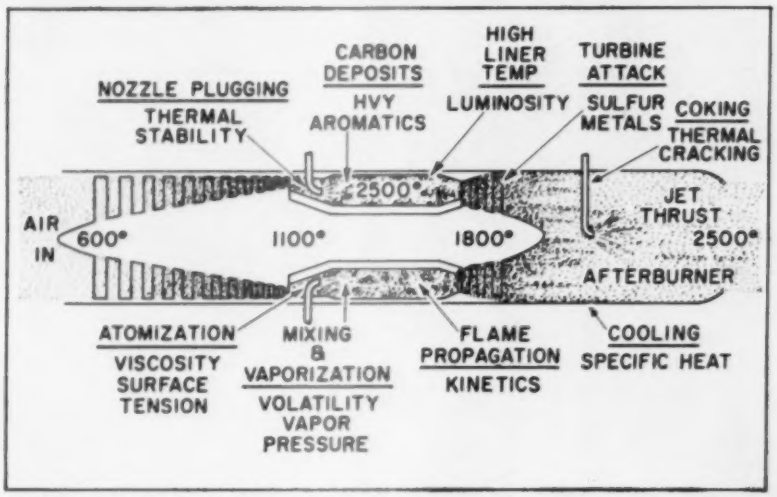
Called endothermic (heat absorbing) fuels, they are currently the subject of a major Air Force research program. Basic goal of this program at present is the evaluation and development of materials that will undergo endothermic reactions and also meet all the other Air Force handling and operational requirements—both before and after reacting—of high-energy jet fuels.

Moreover these reactions, which in effect will turn aircraft engines into small, flying chemical reaction vessels, are expected to entail a number of design problems when the program reaches the hardware development stage. Major problems are expected to arise as, for example, in the development of the new powerplant—probably a combination turbo-ramjet—that will be able to use these new fuels efficiently in the specified flight range. Since these reactions take place in flight, weight will have to be kept to a minimum both in the engine and in the reaction tubes that will surround the engine.

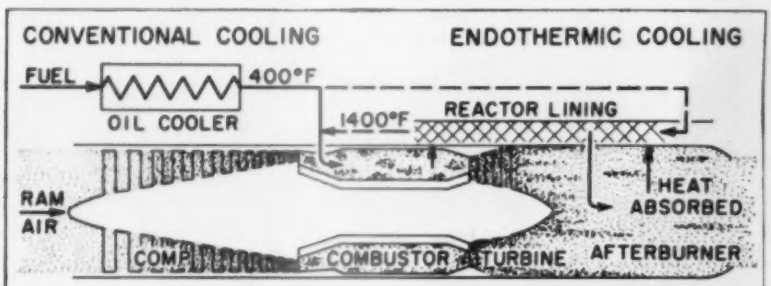
Cooling Agents

These new fuels will absorb more heat than present fuels and will serve as efficient cooling agents for the engine and other components as the lubricating and hydraulic systems, instruments, wheel wells and even the cockpit or passenger cabin. This cooling method will save significant amounts of weight that would otherwise be required for separate refrigeration systems.

Presently available fuels, according to the latest Air Force thinking, are ade-



TEMPERATURE PROFILE of Mach 3 turbojet shows problem areas and why thermal stability and other fuel properties along with thermally and chemically resistant structural materials are essential.



MACH NO.	COOLING REQ'D BTU/LB	HEAT SINK CONV. FUELS		CAPACITY BTU/LB ENDO. FUELS
1	130	170	JP-4	NOT NEEDED
3	450	230	JP-6	USE JP-X?
4	>700	460	JP-X	680–1500

IN CONTRAST to present fuel-heat exchanger system, an endothermic reactor wrapped around an engine makes use of fuel's heat of reaction to raise fuel's heat sink capability.

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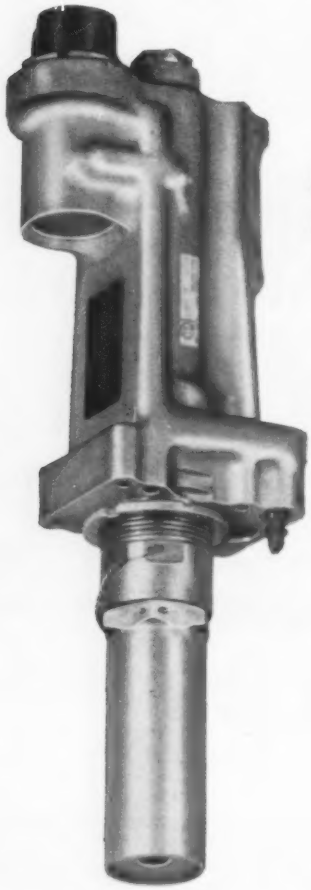

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quate up to speeds of about Mach 3.2. Somewhere between Mach 3.2 and Mach 3.5 the heat buildup in an aircraft takes a quantum jump beyond the capabilities of current fuels. This is where the new endothermic fuels would be used.

Wright Air Development Division awarded the first contract for "Evaluation of Materials as Endothermic Aviation Fuels" to Monsanto Chemical Co. in March, 1959. This contract was for $80,000 and was extended last month to December, 1960, for additional expenditure of $62,000. It is believed that the program will run for at least three years. Some time during this period, perhaps as early as the first part of next year, the Air Force is expected to initiate a joint fuel-engine development program in which Monsanto and possibly other chemical or petrochemical companies would work closely with an aircraft engine manufacturer in developing an engine that could use these new fuels.

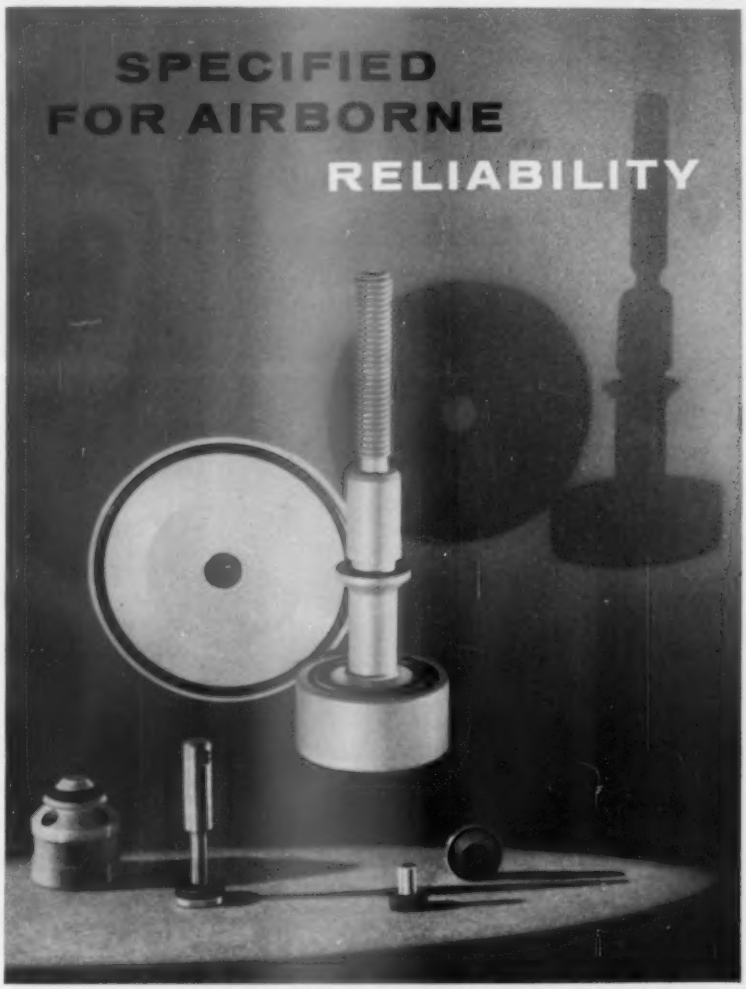
The engine may be a combination turbo-ramjet in which the turbine is bypassed at high speeds and the powerplant acts essentially as a ramjet. It is considered highly unlikely that the powerplant can be an adaptation or a modification of an existing powerplant such as the General Electric J93 or Pratt & Whitney's J58 turbojets designed for Mach 3 aircraft. It is generally conceded that a ramjet engine manufacturer has as much chance at a development contract for the new engine as turbojet engine companies. Most likely contenders for the engine contract, if and when it 'materializes, are General Electric, Pratt & Whitney and Marquardt. All three are reportedly keeping a close eye on current developments in the chemical area.

Esso, one of the early companies in the field, is also paying close attention to current developments in endothermic fuels. Two years ago Esso Research and Engineering Co. undertook company funded investigation of the endothermic decomposition of dicyclopentadiene to cyclopentadiene. At the time, Esso tried to interest aircraft engine manufacturers in a cooperative follow-on to its work. Unable to do so, and having reached a logical stopping place, it dropped the program. Should a research contract or market opportunity appear in the offing, says Esso's W. G. Dukek, Jr., the company would be interested in re-entering the endothermic field since petroleum would probably be the most economic source of the starting materials.

Monsanto is currently concentrating its endothermic fuel research on thermal cracking. Typical of this type of reaction is the cracking or breakdown upon heating of octane into butane and butylene. Heat absorption mechanics of endothermic fuels are essentially as follows:

- **Step 1:** Fuel material temperature rises rapidly from ambient to, say, 800F. In the process, each pound of fuel absorbs approximately 450 Btu., a figure estimated to be adequate for flights at Mach 3. (By comparison, the heat sink capability of JP-4 is 170 Btu./lb.—sufficient for flights up to about Mach 1.5).
- **Step 2:** At 800F the fuel vaporizes, absorbing another 75 Btu./lb. This will boost the aircraft speed potential only to about Mach 3.2.
- **Step 3:** Upon continued heating, the endothermic material is cracked to, say, two new materials, both of which are suitable for use as aircraft fuels. In the process of cracking, the material absorbs another 300 Btu./lb. or so, raising the total heat absorption to about the estimated requirement of 700 Btu./lb. considered necessary for flight at Mach 4.

Besides thermal cracking, there are four other types of endothermic reactions that Monsanto will study. These are dehydrogenation, isomerization, Diels-Alder (which includes reactions of the type performed by Esso researchers on the dedimerization of dicyclopentadiene), and the formation of stable free radicals. There is also the possibility that two or more of these



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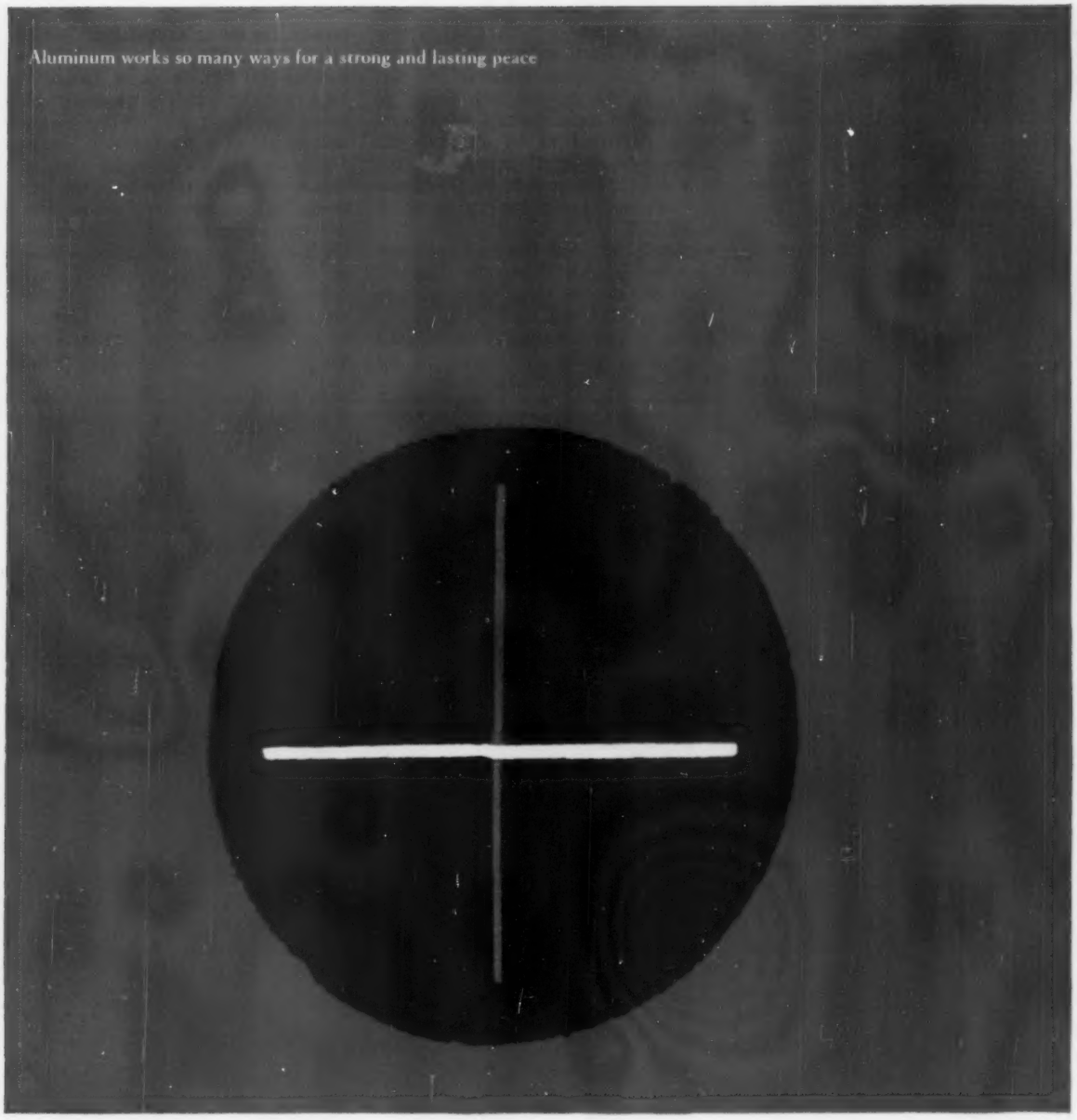

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reactions could be used together.

While many endothermic type reactions are commonplace in chemical and petroleum operations, free radical formation is not. Free radicals are still considered in the realm of the exotic and highly theoretical. However, they hold the promise of a heat-absorbing capability higher than that offered by any of the other types of reaction.

More commonplace and practical, dehydrogenation also provides high heat sink potential, in some materials as high as 1,500 Btu./lb. at 800F. In addition, dehydrogenation can provide free hydrogen as one of the reaction products. Results of recent work indicate that hydrogen possesses a remarkable stabilizing effect, particularly in the flameholder of an afterburner or a ramjet engine, owing to its high burning velocity and wide range of combustibility which enable hydrogen to burn under almost any flight conditions while other fuels would tend to flame out.

A considerable amount of work remains to be done on all types of endothermic reactions. For one thing, a great deal of research remains to be done on the fuel compounds. Not only must these materials lend themselves to endothermic reactions, they also must meet all the other handling and operating requirements—both before and after reacting—of high performance aircraft fuels. Among other properties, for example, they must have high energy content per pound and per gallon, thermal stability, low volatility, low luminosity, low-temperature flow ability, and low sludge formation. Often, as Esso's Dukek told the Delaware Valley regional meeting of the American Chemical Society, improvement in one of these properties means a compromise in some of the others.

Weight of Catalyst

The endothermic reactions themselves present problems. In some cases the reaction requires a catalyst to precipitate it. This could mean the additional weight of a catalytic bed wrapped around an engine, and a catalyst can be poisoned by coke formation or other deposits on the catalyst which seriously impair its efficiency. In non-catalytic reactions, coke or other deposits can form on the surfaces of the reaction tubes, blocking flow and causing serious pressure drops.

In some cases, the high initial temperatures required for the reaction to take place go beyond or critically stretch the capability of present day structural materials.

After these problems are solved, engine development will give rise to a host of others. In effect, a small chemical plant will have to be designed to

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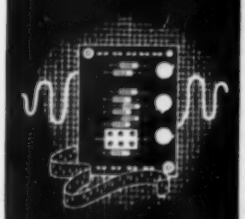

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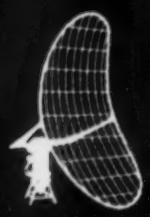

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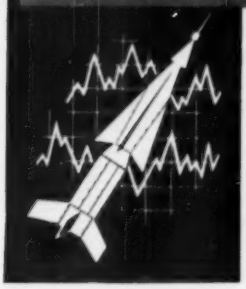
In recent years, Sylvania has developed numerous types of broadband receivers, signal analyzers, and sensing devices across the entire spectrum. Advanced anti-intrusion devices are now under development. In addition, Sylvania is developing and managing several other highly classified programs in this area.



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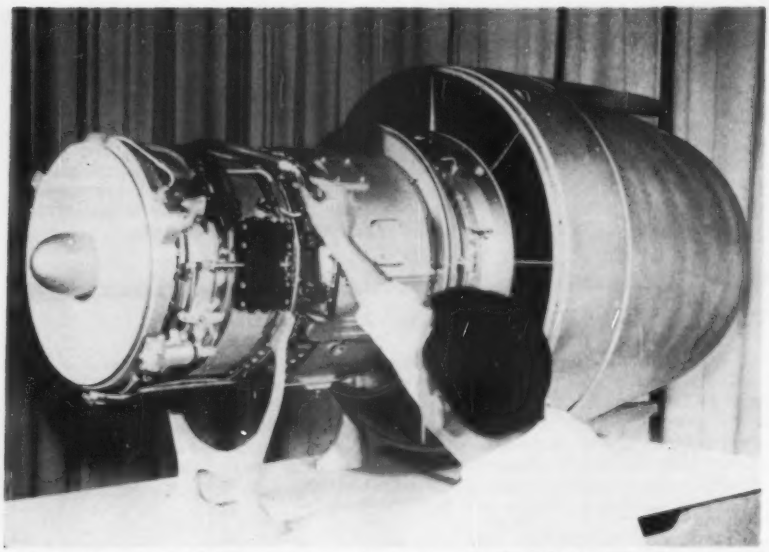

Mockup of General Electric CF700-1 Turbofan

Full-scale mockup shows configuration of General Electric's CF700-1 turbofan engine designed for executive jet transports (AW Mar. 7, p. 334). First engine, rated at 4,000 lb. thrust, will be assembled in April. Over-all length is 69 in. (AW Oct. 19, p. 128).

handle high flow rates, to convert material in yields close to those theoretically attainable, and to have a long trouble-free life under the most adverse conditions that ever surrounded the operation of a chemical plant. The aircraft engine itself will undoubtedly entail numerous development problems. Working in the comparatively unplumbed area of turbo-ramjet engines, the designers will have to come up with a combination engine capable of efficiently burning two or more chemically and physically different fuels. It is even conceivable that the engine will be called upon to burn a liquid and a gas at the same time.

Cost of the new endothermic fuels, while significantly higher than that of current jet fuels, is not expected to constitute a noticeable drawback. Best estimate at present is that the new fuels will cost somewhere around $1/gal. which, as one fuels man points out, "is pretty reasonable when you consider the job they're going to have to do."

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Fuel Pipeline Set For London Airport

London—Shell-Mex and B.P., Ltd., will start first pipeline deliveries of aviation fuel to London Airport next month. Two six-inch diameter pipelines, initially pumping at about 30,000 gph., will connect the firm's Walton depot, on the south side of the River Thames, with two storage points at the airport. The lines run underground for about 9 mi. entering the airport's perimeter after about 6½ mi.

It is estimated that total fuel deliveries by Shell and B.P. to aircraft at London Airport will increase this year by one-third over 1959.

London Airport hitherto has been fed by an average of 40 road tankers a day from Shell-Mex and B.P.

Esso Petroleum Co. also is planning a 75 mi. products pipeline from its Fawley refinery to a distribution depot near London Airport.

Dynamometer to Test Jet Aircraft Tires

Akron, Ohio—Powerful, multi-stage dynamometer system is now in operation here helping Goodyear Tire & Rubber Co. develop high speed tires for jet aircraft.

The 8,600 hp. unit cost $2 million to build and is capable of duplicating all the taxiing, takeoff, landing and roll conditions encountered by modern aircraft tires. Acceleration and deceleration capabilities of the machine, says Goodyear, exceed present and anticipated aircraft requirements. The unit was built by Adamson-United Co.

On one side of the machine there is a tire-on-tire unit which duplicates load conditions; tires are pressed together, tread-to-tread, and then driven at surface speeds up to 510 mph. On the other side of the machine there is a 10-ft. flywheel with a tire carriage on either side. This unit can duplicate loads up to 80,000 lb. and surface speeds up to 320 mph. as well as yaw and camber conditions.

To simulate a landing, for example, the flywheel is speeded to the equivalent of 200 mph. Then a stationary tire, yawed or cambered as desired, is jammed against the flywheel under a load of 30,000 lb. Working automatically under the direction of an X-Y recorder converted into a programer, the flywheel and tire slow down, eventually coming to a complete stop, while the simulated load is maintained on the tire throughout the landing roll period.

At present, military specifications for aircraft tires call for tire-on-flywheel tests. But some Goodyear engineers do not believe that this test gives an accurate representation of landing or taxiing conditions. In reality, they say, that part of the tire in contact with the runway is actually flat while, in a flywheel test, that part of the tire in contact with the unyielding metal flywheel, becomes concave. The tire-on-tire test wherein the wheels flatten out, gives a truer representation, they say and hope to prove to the Air Force.

In the near future, Goodyear plans to add an oven to the dynamometer system. The oven will be lowered onto the tire. After heating, the tire, which will be mounted on the dynamometer, will be tested within 60 sec. after the oven is removed. The oven will enable Goodyear researchers to simulate the heat-soaking aircraft tires will undergo in

prolonged high speed flight. Goodyear, which has recently completed a two-year study for the Air Force on the feasibility of developing tires (as well as wheels and brakes) capable of service at temperatures up to 800F, considers the biggest problem in this area to be the development of new synthetic fibers which will have most of the desirable properties of rubber, plus a high temperature resistance which rubber does not have.

With the research assistance of major chemical companies, Goodyear engineers believe they could develop the high-speed, high-temperature landing gear assembly and are proposing to the Air Force on a follow-on contract for development of actual hardware.

PRODUCTION BRIEFING

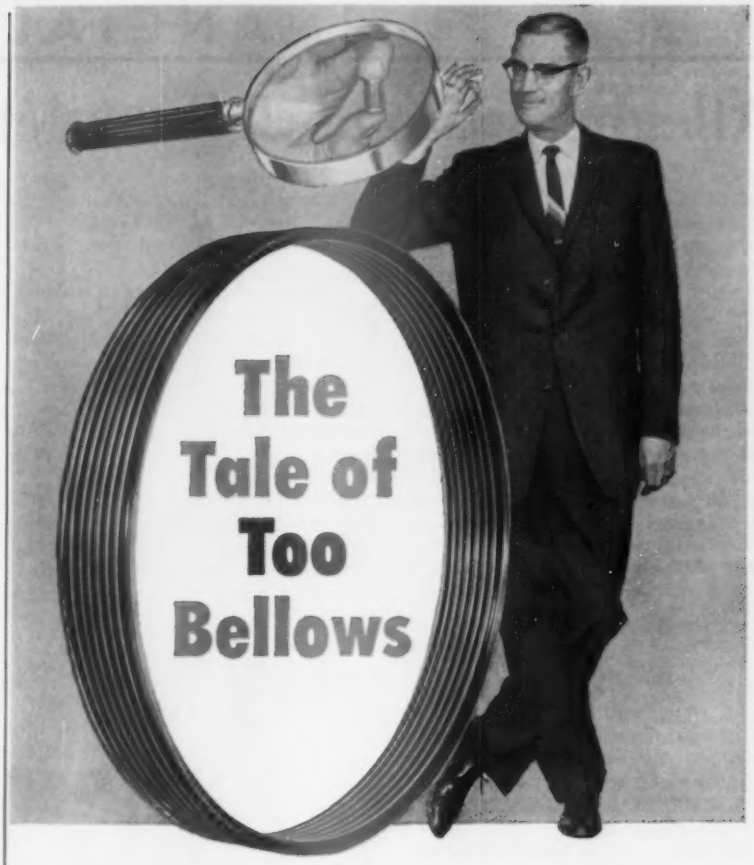
Sales of $486,000 were recorded in 1959 by Electronics Equipment Engineering, Inc., Dallas, Tex., which specializes in design and production of cockpit instruments and control equipment. Last year's sales compare with $221,000 in 1958. The company, which started in 1956 with five employes, three products and one customer, now has 56 personnel, 22 customers and 47 products. As of January, 1960, its backlog, including that of Pan-Air Electronics Corp., Burbank, Calif., a subsidiary, totaled $895,000.

Contract to build 240 signal conditioning modules for Pershing missile has been awarded to Southwestern Industrial Electronics Co., Houston, Tex., by the Martin Co., Orlando, Fla.

Contract for about $2 million covering follow-on production of stabilizer, fin and rudder components for the F-105 Thunderchief fighter-bomber has been awarded Cessna Aircraft Co.'s Military Division by Republic Aviation Corp. Contract extends Cessna's tail components work through mid-1961.

German subsidiary for sales, service and production has been formed by Collins Radio Co. Collins Radio Company GmbH, Flughafen Rhein/Main, Frankfurt, will serve Europe, the Middle East and Africa. William Dunn is manager of the subsidiary, Floyd Gleason heads technical activities.

Hayes Aircraft Co., Birmingham, Ala., will produce ground support equipment for the Saturn space vehicle under $300,324 contract from the Army Ballistic Missile Agency. The contract calls for the design, development and documentation of mechanical, electrical and electronic components for the Saturn ground support equipment.



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MR. CONTROLS

Allegheny, Mohawk Complete Refinancing

New York—Allegheny Airlines, Inc., and Mohawk Airlines, Inc., two local service carriers with northeastern route structures, last month concluded similar refinancing programs aimed at expanding and modernizing their Convair fleets and at obtaining new working capital.

Both programs entailed borrowing by five- or six-year bank installment notes at 6%—with Chase Manhattan Bank of New York by far the largest creditor—and the offering of convertible 15-year bond issues of $5.5 million at 6¼% for Allegheny and $3.5 million at 6% for Mohawk.

Loan Act

In neither case did the carriers make use of the federal Guaranteed Loan Act, passed in 1958, which authorizes the government to guarantee 90% of the loans sought by airlines to buy new flight equipment. New aircraft and equipment deemed necessary by Mohawk and Allegheny to service recently awarded routes could not be purchased without surpassing the Guaranteed Loan Act's $5 million ceiling.

Allegheny's $11,725,000 over-all expansion program ultimately will add three Convair 540 twin-engine turboprop conversions and seven Convair 340/440s to the carrier's fleet, which now contains two Convair 540s, 12 Martin 202s and 10 Douglas DC-3s.

The carrier, ranked fourth among local service airlines in revenue passenger miles flown during 1958, expects Napier Engines, Inc., a subsidiary of D. Napier & Son, Ltd., of London, to deliver the last turboprop conversion equipped with Napier-Eland engines by Sept. 16.

Lockheed Agreement

In a separate agreement with Lockheed Aircraft Corp., Allegheny will purchase for $3,700,000 11 Convair 340/440s that Lockheed accepted from National Airlines as part payment on an Electra order. Four of these, in turn, will be delivered to Napier for conversion to 540s in 44-seat configurations. In addition, one of the two 540s now being leased by Allegheny will be purchased for $875,000 from Napier after modification.

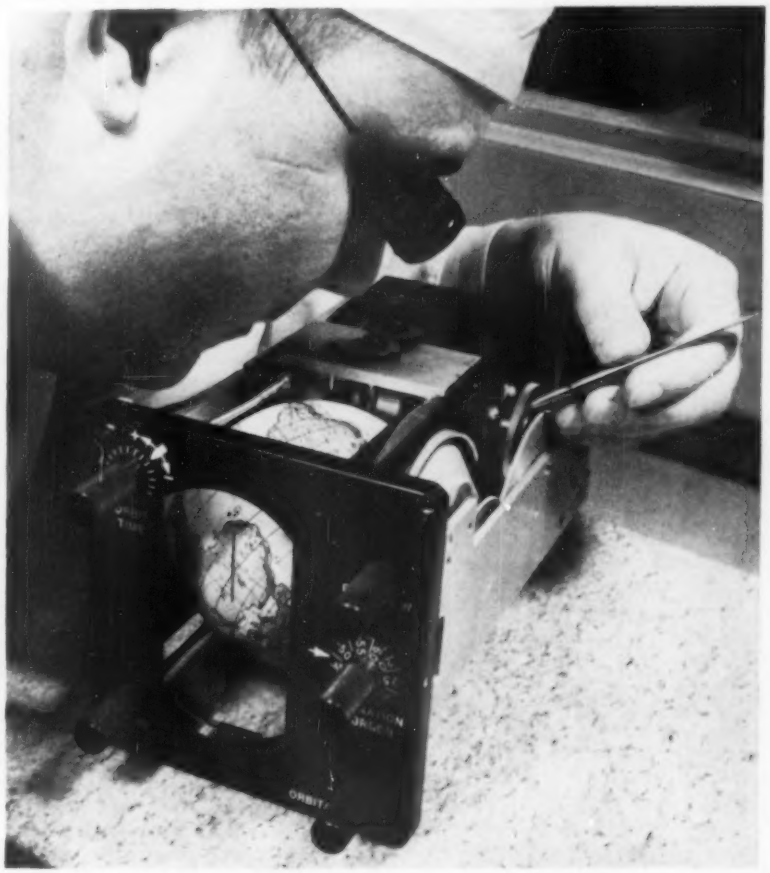
As payment for the conversions, Napier is accepting from Allegheny $3,375,000 worth of promissory notes maturing in 1967. The airline has agreed to amortize 13⅓% of the loan's face value in the first five years and 86⅔% in the last two years. While reserving an option to pay cash, Allegheny now intends to complete payment to Napier with one of the Convair 340/440 airframes purchased from Lockheed.

To finance the balance of its re-equipment program, Allegheny is borrowing $3 million for five years at 6% from Chase Manhattan and from the Riggs National Bank of Washington, D. C. Over-all effect of the company's recapitalization will be to increase its funded debt from about $2 million to about $12.5 million.

When books were closed on Allegheny's $5.5 million bond issue on Feb. 12, better than 95% of the bonds had been placed. Auchinloss, Parker & Redpath—a firm acting as representative for the carrier's 28 underwriting houses—reported that three mutual funds had bought some of Allegheny's new bonds.

Second ranking local service carrier in revenue passenger miles, Mohawk is allocating approximately $8.5 million raised through bond sales and installment notes as follows:

- **$4,180,000** for five new Convair 440s in 50-seat configurations, and parts inventories. The last of these Convairs was placed in service on Jan. 18, expanding Mohawk's active fleet of eight DC-3s and seven Convair 240s.
- **$1,027,025** for working capital.
- **$600,000** for miscellaneous trade debts outstanding.
- **$225,000** to equip fleet with radar.
- **$207,000** to retire a portion of company's funded debt.
- **$150,000** to improve air conditioning



Honeywell Develops Mercury Earth Path Indicator

Globe-type replica of the world is a navigation device for Project Mercury man-in-space project, developed by Minneapolis-Honeywell. Globe revolves to duplicate position of the earth under the capsule, using information relayed by ground tracking stations; bulls-eye sight on the instrument pinpoints the location for the astronaut.

systems on company's Convair 240s.

Mohawk also has announced that the conversion of its Convair 440 fleet, probably to 540s of the type purchased by Allegheny, could be anticipated "during the next several years." This conversion, would require additional financing in unspecified but necessarily "substantial" amounts, Mohawk says.

The $3.5 million issue of 15-year convertibles sold by Mohawk has been divided into two categories. The first, involving $1,582,500 worth of debentures, was a standard sale to underwriters.

The remainder of the issue, $1,917,500, was offered to holders of the company's 5½% convertible bonds scheduled to mature on Aug. 1, 1966.

Bondholders owning $1,449,500 worth of the 5½s outstanding took advantage of the offer. The $468,000 balance of the exchange offer bonds will be purchased by the underwriters.

Another $1 million can be counted on from the sale to Convair Division of General Dynamics Corp. of four Convair 240s which do not conform to Mohawk's standard 240 configuration.

High Demand

General Dynamics, which formed a subsidiary last year to accept 25 DC-7s from American Airlines, described the Mohawk purchase as "a good business deal." Because of high demand for Convair 240s on the used airliner sales market, the company anticipated no difficulty in disposing of the aircraft. Spokesmen for Convair also told AVIATION WEEK that the company's accepting a portion of the Mohawk fleet as a re-equipment trade-in did not signal a change in policy for General Dynamics, which prefers not to involve itself in the sale of used planes.

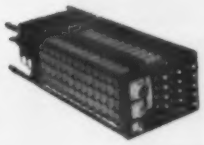
To complete its fund-raising, Mohawk negotiated a $5 million installment loan from Chase Manhattan—due Dec. 31, 1966, and secured by a chattel mortgage on all of the carrier's flight equipment and spare parts.

The carrier's funded debt thus was increased from about $3.5 million to about $8.5 million with a corresponding rise in the company's debt-equity ratio.

Underlying the re-equipment programs on which both Allegheny and Mohawk have embarked is the New England route decision of the Civil Aeronautics Board, effective Feb. 23. This awarded Mohawk the right to serve Cleveland from most of the carrier's previously authorized stops in central New York and, in addition, a new route from Boston to New York City via Providence and White Plains. The company plans to begin service on these segments toward the middle of this year.

In the same CAB decision, which

Airborne Time Code Generator illustrates high-density packing obtainable with T-Series circuits.



Hinged arrangement of mounting panel facilitates accessibility.

The finished package weighs only 20 lbs.; measures 5" x 8" x 20⅜". Unit generates 14-digit Point Mugu code, modulating a 1 kc carrier plus a dc time code. Three sine wave and four pulse outputs are also provided, all with only 96 T-Series circuits and 77 watts of input power.

FROM SYSTEM SPECS TO BREADBOARD TO FINISHED PRODUCT IN 75 DAYS!

That's the record set by the manufacturer of this complex airborne Time Code Generator — thanks to the compatibility of proven EECO T-Series Circuit Modules and the flexibility of the EECO Breadboard Kit.

Designed and developed for testing the fire control of manned supersonic aircraft under actual flight conditions at altitudes up to 80,000 feet, this Time Code Generator employs T-Series circuits throughout. Required accuracy of 1 part in 10^6 was easily obtained.

HIGH DENSITY, LIGHT WEIGHT

The total package contains 96 T-Series Circuits, 14 filament-type EECO Minisig Indicators, and power converters (the beginning of our line of compact 12-volt EECO Power supplies for use with T-Series circuits) — all within a volume of ½ cubic foot. In spite of this terrific packing density, the equipment still retains extreme ease of accessibility and weighs only 20 lbs. No cooling is required.

T-SERIES VS. VACUUM TUBE CIRCUITS

The use of T-Series transistorized Germanium circuits throughout resulted in great savings as against equivalent equipment designed around vacuum tube circuits. Here are some startling comparisons:

	T-SERIES	VACUUM TUBE
SIZE	800 cu. in.	8,000 cu. in.
WEIGHT	20 lbs. (including power converters)	160 lbs. (plus fan and power supply)
POWER	77 watts	650 watts (plus power for fan)

SAVE TIME AND MONEY

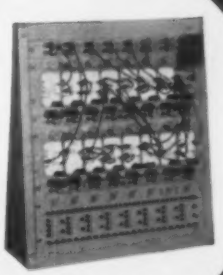
You, too, can develop the most complex equipment in record time with these proven EECO circuits and systems development aids. They'll save you time and money in four major areas:

1 **DESIGN** — You can devote full time to system design problems or unusual circuit requirements, knowing that routine circuit detail has been compatibly pre-engineered and packaged for you.

2 **BREADBOARD** — The unique EECO Breadboard Kit and plastic circuit cards enable you to set up, change, or take down experimental arrangements quickly — without waste of time or materials. Unit contains all necessary permanent wiring to accommodate any regular T-Series circuit. All other circuit inter-connections are made by patch cords or plugs, with prepunched circuit cards to guide you.

3 **PRODUCTION** — Your production problem is reduced to one of mounting sockets on panels or chassis and providing simple socket-to-socket wiring. Plug in the appropriate circuits and the system is complete.

4 **CHECKOUT**—The extreme reliability of T-Series circuits eliminates the need for circuit "debugging." Checkout time is reduced to a bare minimum.



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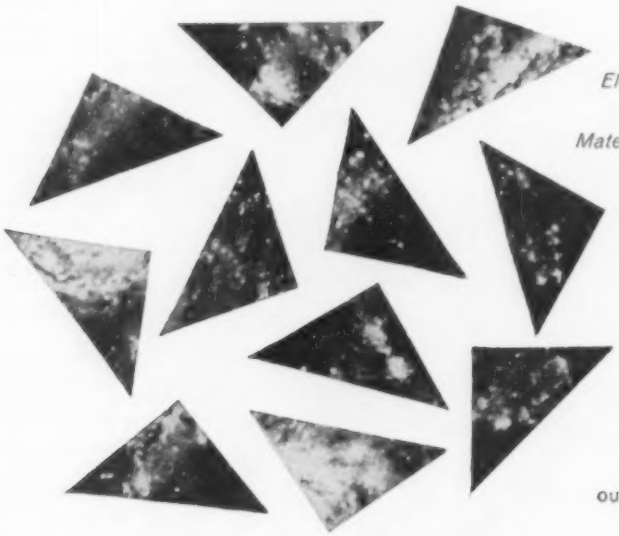

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placed the two local service carriers in direct competition with some major trunklines, Allegheny was authorized a new route connecting the co-terminals of Washington, D. C., and Baltimore, with Boston. Intermediate stops at Wilmington, Philadelphia-Camden, Trenton, New York-Newark, Islip, Bridgeport, Hartford-Springfield, New London and Providence also were granted. Service on these segments will be inaugurated by Mohawk in the spring of 1960.

Even before the outcome of CAB's Northeastern States Area Investigation, however, Mohawk and Allegheny were registering healthy gains in traffic volume. In 1954, for example, Allegheny reported flying 42,565,000 revenue passenger miles. By 1958, this figure had climbed to 84,196,000, an increase of 97.8%. Even more striking is a comparison of the last 10 months of 1958, during which the carrier flew 69,468,000 passenger miles, and the last 10 months of 1959, when 83,555,000 passenger miles were recorded.

Mohawk reported an equivalent growth rate, jumping from 40,006,000 revenue passenger miles in 1954 to 87,291,000 in 1958. More recently, Mohawk's revenue passenger miles increased from 61,223,000 for the last nine months of 1958 to 80,432,000 for the last nine months of 1959.

New Offerings

Anadite, Inc., South Gate, Calif., engaged in metal processing and finishing for military and commercial applications. Offering is 50,000 shares of capital stock for public sale; offering price and underwriting terms to be supplied by amendment. Of the proceeds, $40,000 will be applied as a cash down payment on the purchase of certain real property and plant facilities now under lease; $48,000 to repay a bank loan obtained for working capital purposes; balance will be added to working capital.

Electro Instruments, Inc., San Diego, Calif., engaged in the design, manufacture and sale of electronic test equipment. Offering is 120,135 shares of common stock; 53,000 shares are outstanding and are to be offered for sale by the present holders, and 25,000 shares are to be issued and sold by Electro. Public offering price and underwriting terms are to be supplied by amendment. Offer also includes an additional 42,135 shares issuable under outstanding options granted pursuant to the company's Restricted Stock Option Plan for officers and key employes. Proceeds of the sale of the 25,000 shares will be used as follows: $650,000 for construction of a new plant on a newly acquired tract in San Diego; $100,000

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New freedom from in-flight calibration is provided by stability of input impedance and lack of sensitivity to change source impedance.

Let us send you complete details on the new Bendix-Pacific Model TOE-300 Oscillator.

CONDENSED SPECIFICATIONS

AVAILABLE BANDS: All standard IRIG numbered and lettered bands.
OUTPUT: 4.0V rms open circuit.
OUTPUT IMPEDANCE: 100 kilohms.
LINEARITY: ±0.25% bandwidth deviation from best straight line.
STABILITY: ±1.0% of bandwidth, 0°C to 85°C; ±0.25% —15 min. to 8 hours at 25°C.
POWER: 20V at 6 milliamperes.
SIZE: 1.30"x1.60"x0.77", approx. 1.5 cu. in.
WEIGHT: Approx. 2.5 oz.

Bendix-Pacific
DIVISION OF BENDIX AVIATION CORPORATION
NORTH HOLLYWOOD, CALIFORNIA

Sabena Boeing 707-320 Arrives at Jan Smuts Airport

Sabena Belgian World Airlines' first Boeing 707-320 jet transport (AW Nov. 16, p. 50) refuels at Johannesburg, South Africa, following its maiden trip to Jan Smuts Airport. Two new refuelers, developed by Air Total Service, serviced the aircraft with 16,000 gal. of fuel in 15 min. The units were built by L. H. L. Engineering Co. of Germiston.

for fixtures and equipment in the new plant; $500,000 to retire indebtedness incurred for the purchase of a subsidiary, International Electronics Manufacturing Co., and to supplement working capital; balance will be added to working capital.

Electronic Research Associates, Inc., Cedar Grove, N. J., engaged in the development, manufacture, and sale of highly technical and specialized transistorized devices, packaged circuits, etc., used in the manufacture of commercial and military electronic equipment. Offering is 216,254.5 shares of Class A Capital Stock in exchange for an equal number of shares of Class B Capital Stock on a share for share basis. Certain stockholders may subsequently offer their Class A shares to the public at prevailing market prices at the time of such offerings.

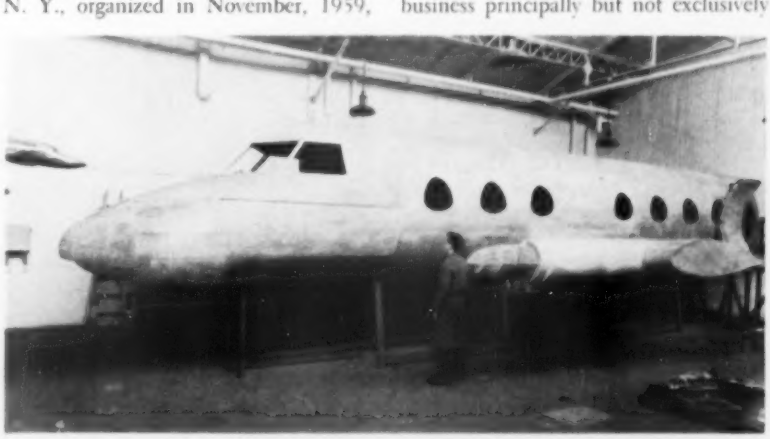
Elco Corp., Philadelphia, Pa., engaged in the manufacture of basic components used in electronic and electrical equipment. Offering is 88,135 shares of common stock reserved for issuance upon the exercise of outstanding warrants. Warrants were issued in part (50,000 shares) to S. D. Fuller & Co.; Fuller & Co. transferred 9,090 warrants to certain dealers and the balance to partners of the firm.

Data-Control Systems, Inc., Danbury, Conn., engaged in the design, production and sale of telemetry systems and related components. The company recently offered 75,000 shares of common stock, at $10 per share—the first public sale of the common stock. The new issue was over-subscribed and is selling at a premium. Proceeds will be used to reduce the outstanding amount of the company's bank borrowings.

Glass-Tite Industries, Inc., Providence, R. I., engaged primarily in the manufacture of hermetic seals used in transistors, diodes, condensers, etc. Offering is $500,000 of 6½% convertible subordinated debentures and 25,000 shares of common stock for public sale. Offering price of the debentures to be 100% of principal amount, with a 9% commission to the underwriters; offering price and underwriting terms on the stock to be supplied by amendment. Proceeds will be used for reconditioning additional space to be leased at the Providence plant; for acceleration and expansion of production of new product lines; for additional inventories; for equipping and installing machinery in a new plant to be located in lower California; balance will be added to working capital and used for general corporate purposes.

Missile Electronics, Inc., New York, N. Y., organized in November, 1959, to engage in the design, manufacture and sale of electronic, mechanical and other equipment pertaining to rockets, missiles, space vehicles and satellites. It is said to be the exclusive licensee of Missile Dynamics, Inc., under nine U. S. patents in this field. Offering is 214,500 shares of common stock, to be offered for public sale at $3 per share; 200,000 shares to be offered for sale by the issuing company and 14,500 shares (not outstanding) by the holders thereof. Proceeds are to be used for machinery and equipment; as a reserve for investigation and prosecution of patent infringements; for research and development; for working capital; for expenses of the offering.

Aviation Employees Corp., Washington, D. C., organized in November, 1959, and, through three subsidiaries, expects to engage in the writing of insurance; the corporation will seek business principally but not exclusively



Potez Builds P.840 Feederliner Mockup

Mockup of the Potez-Air Fouga P.840 turboprop feederliner (AW Feb. 29, p. 50) is partially completed. Four Turbomeca Astazou turboprops have been certified at 470 eshp. on takeoff.

from potential customers who are employed in the aviation and air transportation industries. Offering is 2,500,000 shares of common stock, to be offered for public sale at $2 per share. Majority of the proceeds will be invested in the shares of the three subsidiaries; of the balance, part will be required for general corporate purposes during the first two years of operations, and the remaining will be used from time to time for the purchase of all or a substantial interest in or the formation of one or more other companies engaged in the business of insurance or finance or to further supplement the funds of the three subsidiaries.

Barnes Engineering Co., Stamford, Conn., engaged in the design, development and manufacture of infrared and electro-optical components, instruments and systems, with emphasis on research and development for military application. Offering is 50,000 shares of common stock for public sale; offering price and underwriting terms to be supplied by amendment. Of the shares, 28,000 are outstanding; the remaining 22,000 to be offered by the company. Proceeds will be used to prepay the company's 6% installment notes due November, 1964; for expansion and improvement of manufacturing facilities, etc.; balance will be added to working capital and used for general corporate purposes including company-sponsored research and development.

Financial Briefs

Airwork Corp. net income for the half year ended Jan. 31 was $185,917 or 26 cents a share on 720,774 common shares outstanding on sales of $5,754,478. At the end of the corresponding period last year net earnings were $116,427 or 16 cents a share on the same number of shares, based on sales of $4,841,694.

Electronic Assistance Corp. stockholders approved an amendment to the certificate of incorporation which will permit a two-for-one split of common stock. The company manufactures communications, radar and ultrasonic apparatus.

Minnesota Mining & Manufacturing Co. net income on worldwide operations for 1959 was $63,564,729 on sales of $500,675,932. Earnings per share of common stock were $3.74. Last year, when only export and Canadian operations were consolidated with domestic operations, omitting other foreign subsidiaries, earnings were $43,879,033 on sales of $376,293,016. Earnings per share of common stock were $2.58. Comparable 1959 figures are earnings of $60,262,440 on sales of $446,580,323, and per share earnings of $3.54.

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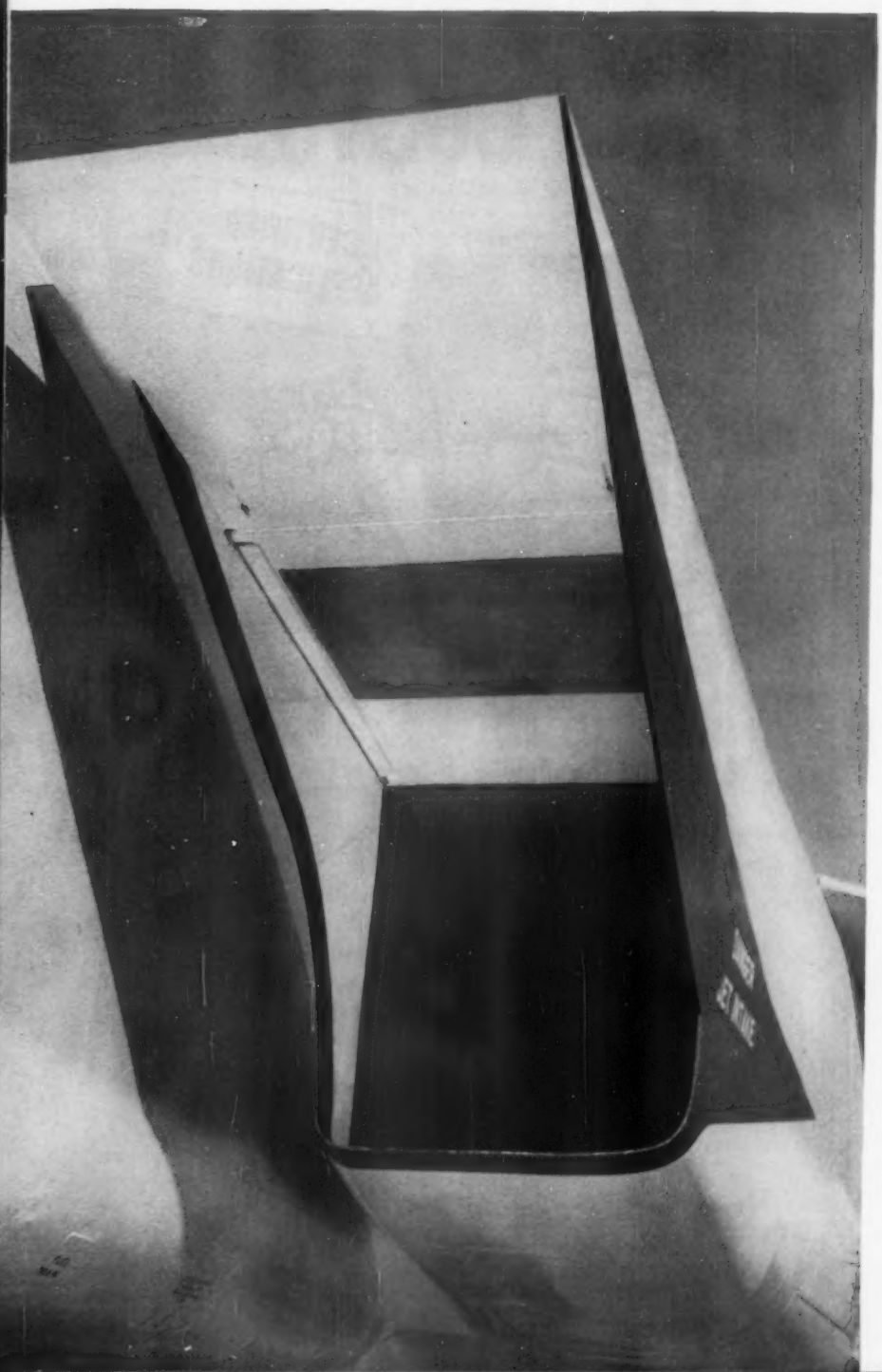
ULTRASONIC CLEANING SYSTEMS

Corrosion-Fighting Titanium Sheet Paves Way for Honeycomb in Navy A3J



Titanium metal's corrosion resistance has enabled North American Aviation designers to draw upon the stiffness and light weight inherent in honeycomb-core construction for the inlet guide ramps of the Navy's Mach 2 attack aircraft, the A3J Vigilante.

• Titanium metal, immune to salt water corrosion build-up, has proved so effective in replacing aluminum cover sheets and channels that existing A3J aircraft will be retrofitted with the new design. The overall weight saving—in effect a design bonus—is 22 percent.

Installation of titanium in this assembly is the latest step in the continuing trend of designers to capitalize on titanium's unique combination of intrinsic properties: low density (0.16 lb./cu. in.), great strengths, outstanding corrosion resistance, and ability to retain its properties under long-time exposure from −300°F up through intermediate temperature ranges. Its effectiveness under conditions of short-time exposure was seen in its use as the nose-cone tip of the Vanguard where titanium withstood temperatures of 1500°F.

The A3J inlet ramps are made of flat, tapered titanium sheets adhesive-bonded to an aluminum honeycomb core. Each assembly is about 5 ft. long, 2 ft. wide, and 3 in. thick, with 16,000 holes drilled through the skin, to control air flow to the engine. Because a large volume of air flows through these holes, a small amount of corrosive product build-up would seriously impair the ramp's performance.

An integral part of the panel is an I-beam-shaped titanium alloy rib which connects the ramp to its actuator. This rib, machined by North American from a Ti-6A1-4V

heat-treated forging, weighs about 6 lb., and is riveted into the panel.

To take advantage of the corrosion resistance properties of titanium in this application, North American worked out two machining operations and an adhesive bonding technique.

MILLING THE FACE PLATES: The titanium face plates are tapered, from 0.090 in. thick at one end to 0.045 in. at the other. This taper is achieved by milling the sheet, in one pass, with HSS cutters. During the operation, the work is completely submerged in a solution of one part denatured alcohol and three parts water. Cutting speed is 180 rpm, with feed rates from 5 to 20 ipm.

ADHESIVE BONDING: The tapered skin is bonded to the honeycomb core with Bloomingdale Rubber Company's HT-424 adhesive. A four-step preparation was developed for this operation: vapor degrease, acid pickle (25-35% HNO_3 plus 2-4% HF), application of fluoride phosphate coating, and hot water rinse.

DRILLING 16,000 HOLES: After the skin is bonded to the honeycomb core, 16,000 holes 0.050 to 0.060 in. diameter are multi-spindle drilled through the skin, in a milling machine setup with a 130-spindle gearless drillhead. The HSS drills have short shanks, to minimize wear and breakage. Cutting fluid is a soluble-oil emulsion.

North American's use of titanium primarily for corrosion resistance highlights one of the properties of titanium metal attractive in construction of:

- **ENGINES: Titanium metal eliminates the possibility of stress-corrosion or salt-water-spray pitting with its consequent fatigue damage of compressor, turbine blades and other engine parts. This is of unusual importance to commercial carriers who expect their new jets to operate 8 to 10 trouble-free hours daily. Weight advantages can provide significant economies in fuel savings alone, during seven years of operation.**
- **MISSILES: Titanium metal provides excellent resistance to the corrosive effects of rocket fuels such as liquid fluorine and ammonium perchlorate, at the same time providing minimum weight structure and outstanding cryogenic properties.**

Price reductions in titanium metal and mounting experience in working with titanium have enabled fabricators to produce assemblies with competitive advantages that more than outweigh materials cost differentials.

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MULTI-SPINDLE DRILLHEAD mounted in milling machine makes 130 holes per pass. Surface has 16,000 holes 0.050 to 0.060 in. in diameter. Former parts were made of aluminum, which corroded and interfered with proper air flow

HONEYCOMB CORE MATERIAL is being adhesive-bonded to titanium spar (machined from Ti-6A1-4V forging), and will subsequently be bonded to tapered titanium sheet. Total weight saving of 22% is a bonus to the manufacturer. Titanium was chosen for its corrosion resistance

ULTRASONIC PROBE TESTS for completeness of bond between core and skin. Bracket at center of ramp assembly is part of a Ti-6A1-4V titanium rib, machined at North American from a Wyman-Gordon Company forging. Bracket is connected to actuator, to control pitch of inlet guide ramp

EXPERIMENTAL STOL aircraft, Germany's Kiebitz LF2, is aimed at transition training for glider pilots.

Kiebitz LF2 STOL Has Folding Wings

KIEBITZ LF2 has uses ranging from training to glider towing and crop dusting.

By Edith Walford

Oedheim, Germany—Germany's newest experimental STOL aircraft, the two-seat Kiebitz LF2 monoplane, will be produced here under license by Merckle Flugzeugbau GmbH.

The Kiebitz has been under development for two years and now is completing its flight test program prior to production. Under the terms of the license agreement, Merckle may subcontract production to foreign manufacturers.

Design Team

The plane was designed by a team of engineers at the Technische Hochschule Braunschweig and will be marketed under the name of Merckle Kiebitz 501.

Like its predecessor, the single-seat LF1 Zaunkönig, two prototypes of which were built by the same group of engineers at Braunschweig during World War II, the Kiebitz was designed primarily for study and training purposes, but also for private flying, towing of gliders, aerial photography and crop-dusting.

One major purpose of its uncompli-

cated design was to enable licensed glider pilots to convert to powered flight after only a short period of ground instruction.

The aircraft institute of the technical college at Braunschweig plans a number of modifications aimed at further improving the Kiebitz' STOL characteristics.

Powerplant is a Continental C 90/12F engine rated at 95 hp. at 2,475 rpm.

Flight tests began last October and the plane has since shown a minimum speed of about 30 mph.; in horizontal flight, maximum speed is about 100 mph.

With extra fuel, range is about 600 mi. Service ceiling is 15,750 ft. Takeoff distance is 246 ft. and landing distance is about 132 ft.

Model Tests

Model tests were made in the wind tunnel of the flow-research institute at Braunschweig. Model was built to a scale of 1:12.5.

Rectangular wings of the Kiebitz have V-struts, adjustable slots, landing flaps and ailerons.

Wings, constructed in two separate parts and fastened to the fuselage in two places, can be folded back, thus reducing hangar space and rent considerably.

Because production of the prototype had to be kept to a minimum, the Kiebitz is generally of composite metal-wood-fabric construction, but the wings are metal-bonded. With the exception of the engine, propeller, landing gear wheels, fuel tank, powerplant accessories and navigation instruments, all parts of the aircraft have been built in the institute's workshops at Braunschweig.

The aluminum doors on either side of the fuselage fold upward toward the wings for entry or exit to or from the aircraft and can be fastened from the inside during flight.

The steel tube, fabric-covered fuselage is built on frames which give it its shape. The tail wheel is attached to the fuselage by a leaf spring. Pedals of the steering control system brake the wheels.

The fabric-covered rudder is attached to the fuselage and has a single wooden spar with plywood nose. The aerodynamic horn balance also carries the mass balance for the surfaces. The single-spar elevator unit with stabilizer is strut-braced to the trailing edge of the fin and has plywood-covered wooden ribs.

Dual controls are mounted on a single column with two wheels and two pairs of pedals, one each for the pilot and student. Brakes are located underneath the rudder pedal tips. Hand lever for the landing flaps is installed between the two seats and controls the slats, flaps and ailerons on takeoff or landing.

Control Rods

With the exception of the rudder controls, all control push rods are made of aluminum. The wing itself with the ailerons and flaps, but not including the attachments, extra fuel tank and controls is made out of wood in the normal manner. Wing is of two-spar construction and includes plywood, middle and end ribs.

Wing fittings are made of steel; ailerons and flaps are built like the elevator unit with torsion nose, main spar and the end ribs, but the latter are fabric-covered.

The engine is carried on a steel tubing mount fastened to the firewall at four points.

Kiebitz LF2 Specifications

Dimensions	
Length	22.37 ft.
Span	35 ft.
Height	6.76 ft.
Wing area	158.92 sq. ft.
Aspect ratio	7.75
Weights	
Empty weight	990 lb.
Useful load	515 lb.
Takeoff weight	1,505 lb.
Wing loading	9.4 lb./sq. ft.
Useful load (percentage of takeoff weight)	34.2%
Performance	
Maximum speed	102 mph.
Minimum speed (flaps)	31 mph.
Takeoff distance	246 ft.
Landing distance	131 ft.
Range	348 mi.

L. B. Smith Rolls Out First Production Tempo II

L. B. Smith Aircraft's executive version of the Douglas B-26, the pressurized Tempo II (AW Aug. 24, p. 131), is undergoing Federal Aviation Agency conformity inspections. First production model carries 10 passengers and has a headroom clearance of 6 ft. 2 in.

COLT 190, powered by 190 hp. Lycoming engine, costs $7,995.

Spibec Corp. Readies Colt 190 Lightplane for June Production

Philadelphia, Pa.—Spibec Corp., which owns design rights on the Colt 190—a four-place, all-metal aircraft conceived by Donald Luscombe in 1941 but never manufactured commercially—has set June 1 as target date to begin production.

Equipped with a 190 hp. Lycoming engine, the standard Colt's tentative sales price is $7,995. This would place the plane within competitive range of the least expensive models of such major producers as Cessna and Piper.

According to Carroll S. Bechtel, one of Spibec Corp.'s three owners, the Colt prototype in existence has been flown more than 350 hr. All engineering data necessary for Federal Aviation Agency approval, with the exception of the static wing loading test, has been completed.

Although no firm orders have been made, Bechtel said production schedules call for the building of 50 Colts the first year and another 50 the second year, with subsequent output to depend upon demand for the airplane. Spibec Corp. plans to incorporate as the Colt Aviation & Engineering Corp.

The present Spibec Corp. was chartered in 1956. Founders' intent was to experiment with glass fiber in lightplane construction but low sales volume of the glass fiber model introduced by Taylorcraft forced the company to cancel its original plans.

Colt 190's design rights and fuselage, wing alignment and gear jigs were purchased for $30,000. Production, assembly and testing of the Colt will take place at one of several airports in the Philadelphia area.

Two distribution systems are being weighed by the manufacturer. Under the first and more probable, the Colt would be marketed from the factory through a network of independent salesmen working on commission. A less likely alternative under consideration is a system of airport distributorships, with operators contracting to purchase a fixed number of Colts each year and providing their own demonstrations of the aircraft.

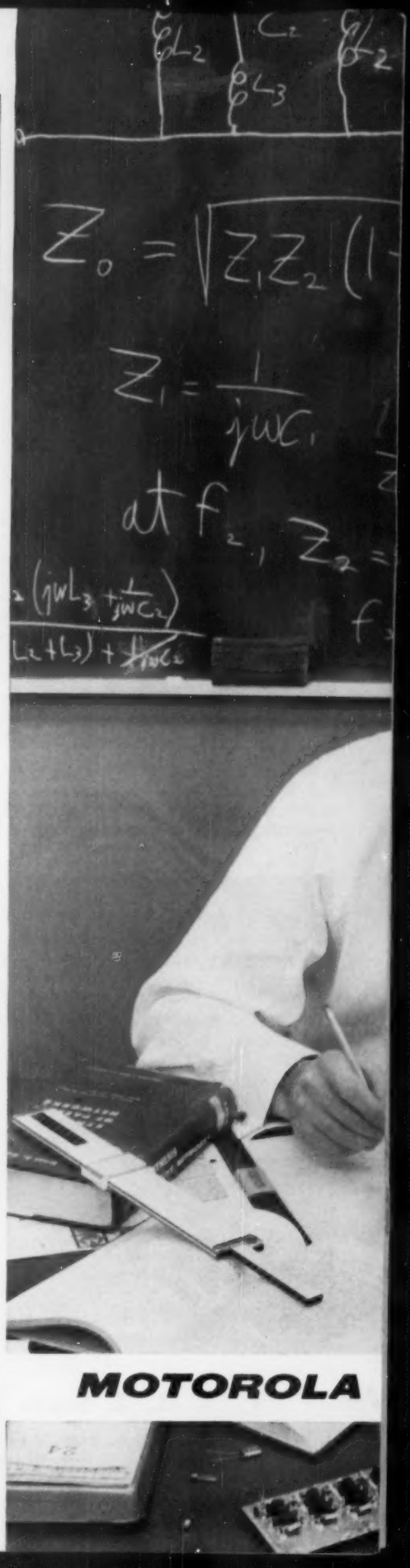
Colt 190 Specifications

Design gross weight	2,600 lb.
Empty weight	1,400 lb.
Useful load	1,200 lb.
Fuel capacity	60 gal.
Oil capacity (Lycoming engine)	3 gal.
Baggage capacity	120 lb.
Wing area	186 sq. ft.
Rated Power (Lycoming engine)	190 hp.
Optional powerplants	Continental E185, E205, E225
Wing loading	14 lb./sq.ft.
Wing span	36.2 ft.
Aspect ratio	7.05
Dihedral	1 deg.
Length	23.87 ft.
Height	7.08 ft.
Cruising speed, 60% power, 8,000 ft.	140 mph. IAS
Maximum cruise speed, 75% power, 8,000 ft.	146 mph. IAS
Maximum dive speed	199 mph. IAS
Stall speed (full flaps)	52 mph.
Rate of climb	90 mph. IAS 1,000 fpm.
Service ceiling	15,500 ft.
Takeoff distance, sea level	485 ft.
Landing distance, sea level	375 ft.
Range, with 45 min. reserve	750 mi.
Price (economy model), tentative	$7,995

Revocation Request Refused by CAB

Washington—Civil Aeronautics Board has refused a Federal Aviation Agency request for revocation of the licenses of two private aircraft mechanics in a Board report which criticizes FAA investigators for delaying 17 months in filing a formal complaint.

Board members upheld a hearing examiner's decision which said that, while the two mechanics—Ciero S. Musso and



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Stephen A. Patka, Jr., of the Tri-City Aviation School near Binghamton, N. Y. —failed to exercise good judgment in the repair of an aircraft which later crashed on a test flight, FAA failed to offer sufficient justification for the revocation of their licenses.

CAB's denial of the FAA appeal climaxed almost three years of investigation and hearing procedures which followed the crash of a Piper Apache at Broome County Airport in Binghamton on Mar. 22, 1957. Witness testified that the aircraft, being flown by a student pilot with Musso as a passenger, appeared to take off in a three-point landing attitude, climbed steeply approached a vertical, nose-high attitude. The plane attained an altitude of between 50 and 100 ft. before stalling and striking the ground in a shallow nose-low attitude. Neither occupant was seriously injured.

CAB said the aircraft was being tested after earlier repairs to the elevator cable by Musso. An FAA witness, who was also employed by the school, testified that Patka arrived on the crash site and moved the control stick to the rear which moved the elevators down instead of up. Another FAA witness said the wreckage was returned to a hangar where Musso was observed doing work within the fuselage. Later, he said, the elevators were again operating normally.

CAB said that, while FAA safety inspectors knew of these actions a short time after the accident, they failed to question either Musso or Patka on these allegations until July of the following year. Evaluating the available testimony, the examiner's findings and FAA's complaints, the Board concluded that the aircraft's elevator control cables had been attached in reverse, causing the crash. Although Musso had checked the plane as airworthy in a log book entry, CAB said that he failed to visually inspect the control system before takeoff. The Board added that later, in the company of Patka, who is also manager of the school, Musso altered the control cables to their correct positions before FAA inspectors examined the wreckage.

Supporting the examiner's decision and denying FAA's appeal to revoke the mechanics' licenses, the Board said that the two men had not denied that there had been a malfunction of the controls or that they had any knowledge of the cause of the accident.

Emergency spare parts in hand, Air Force pilot leaves Cessna U-3A supplier, one of many designated to serve USAF across America.

LOGISTICS PROBLEM—SOLVED BY CESSNA

Problem: to provide the Air Force a quick, easy, economical way to maintain its valuable fleet of Cessna U-3A light twin transports. Solution: a nationwide off-the-shelf support program tied in with Cessna's world-wide support of the U-3A's commercial counterpart, Model 310. In operation nearly three years now, the program has proved a success by many standards. Most important to the Air Force: untold time, trouble and dollars saved.

Low-cost logistics support is just one of the reasons USAF flies the U-3A extensively—and one more of the ways Cessna "Problem-Solving" Research is ever at work enhancing America's future in the air.

Wichita, Kansas

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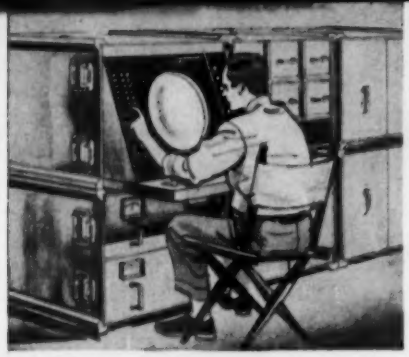
PRIVATE LINES

Expanded facilities, including a 3,000-sq.-ft. terminal building, have been opened for business and private pilots by Coastal Aviation, Inc., Tampa (Fla.) International Airport. Also planned is extensive remodeling of hangar facilities, with total cost of the terminal, remodeling and addition of new equipment by this Cessna dealer expected to exceed $150,000.

New Soviet An-6 single-engine biplane transport, an improved An-2, has supercharged engine for improved high altitude performance. The An-6 is now operating from airports in central Asia, which are from 6,500 ft. to nearly 12,000 ft. above sea level. Airplane often cruises at 16,000-18,000 ft. and has flown above 26,000 ft., Russian reports state.

Cessna 310D is making an extensive demonstration tour of Asia following a 6,675-mi. transpacific ferry flight. The plane will visit 21 countries and cover approximately 16,000 mi. during the tour, which is expected to last until the end of July. A Cessna Model 210 is being shipped by surface transport to India and will accompany the 310D starting in April.

Lysdale Aviation, Inc., Fleming Field, South St. Paul, Minn., has become Falconaire, Inc., and will continue to distribute Cessna aircraft in Minnesota and western Wisconsin. The company was purchased by F. H. Peavey & Co. two years ago.



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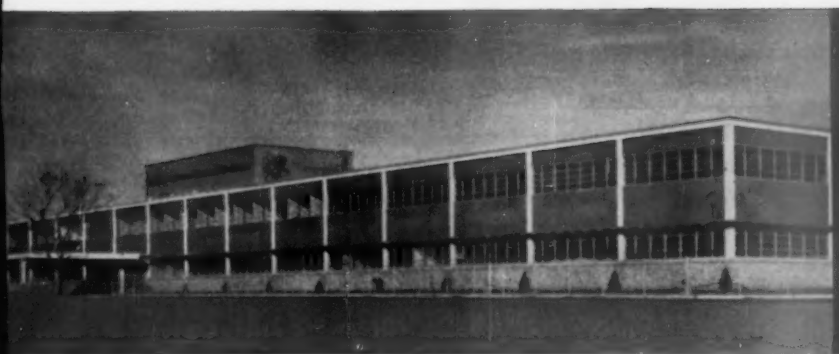

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BOMARC Computer for the U. S. Air Force Target Intercept Program.

SEA SURVEILLANCE SYSTEM FOR THE U. S. NAVY

AN/USQ-20 (Advanced Computer for the U. S. Navy).

Additional information describing capabilities and experience or career opportunities may be obtained by writing to Remington Rand Univac at the above address.

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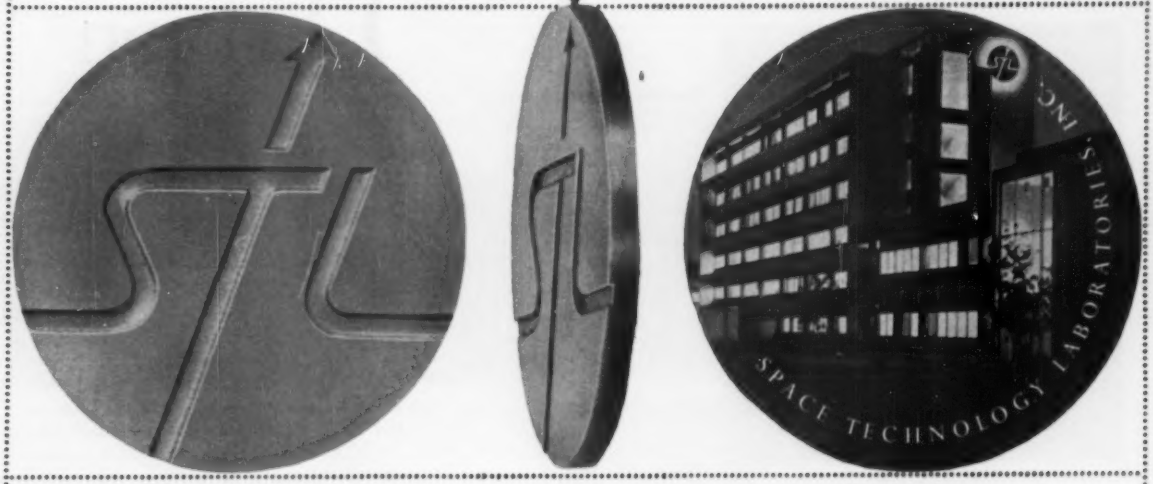

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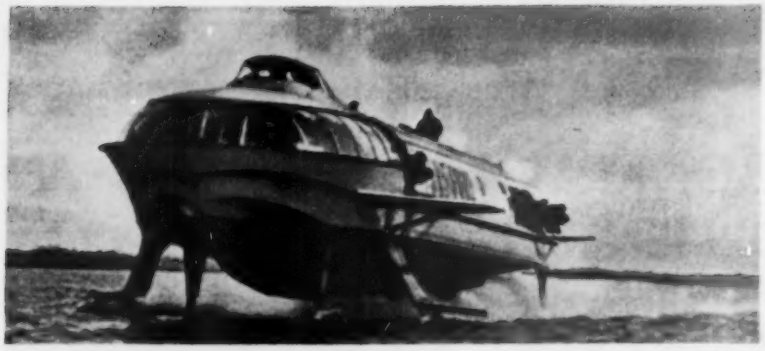


Russians Test 150-Passenger Hydrofoil Boat

Russian program of hydrofoil boat development is being sparked by tests utilizing the "Meteor" a 150-passenger craft which has a duralumin hull. The "Meteor" is scheduled for service this spring. Larger hydrofoil, the "Sputnik," is completing model tests at Krasnoe Sormovo factory; configuration is for 300 passengers. Speed capability is 62 mph.

WHO'S WHERE

(*Continued from page 23*)

In the Front Office

Brian O. Sparks, deputy director of the California Institute of Technology Jet Propulsion Laboratory, Pasadena, Calif.

G. B. Van Dusen, chairman, Van Dusen Aircraft Supplies, Minneapolis, Minn., succeeding the late George C. Van Dusen. Mr. Van Dusen continues as president. Also: **George R. Galipeau,** executive vice president; **William L. Carolla,** vice president and general sales manager; **Robert Winick,** vice president-western operations; **Raymond F. Hall,** vice president-eastern operations.

J. R. Johnson, president, Royal Industries, Inc., Los Angeles, Calif., succeeding M. L. Benson, resigned.

J. Bruce Clyne, vice president-manufacturing, Stanley Aviation Corp., Denver, Colo.

Honors and Elections

Charles E. Beard, president of Braniff International Airways, has received the Republic of Panama's highest civilian honor the "Order of Balboa" for his "contributions toward furthering goodwill between the Americas through his development of international aviation."

Dr. Chao C. Wang, electronics scientist at Sperry Gyroscope Co., has been awarded the Victor Emanuel Distinguished Professorship at Cornell University for the Spring 1960 term. Dr. Wang is the fourth recipient of the honor which is awarded to "persons of broad technical competence whose interests extend into many fields of science and engineering."

Changes

The Airplane Engineering Division of McDonnell Aircraft Corp., St. Louis, Mo., has announced the appointment of the following assistant chief engineers: **Robert J. Baldwin** for Weapons Support Engineering, Electronics, Reliability, and Human Factors; **George S. Graff** for Structures, Strength Weights, Structural Dynamics, Thermodynamics and Loads, Aerodynamics and Propulsion.

D. C. MacArthur, head of the newly established Caravelle program management office for Douglas Aircraft Company, Inc., with headquarters at Sud Aviation, Paris, France.

Harold H. Dice, general manager, Allison Division of General Motors Corp., Indianapolis, Ind., succeeding **E. B. Newill,** retiring.

Raymond J. Miller, marketing manager, Erie Pacific Division, Erie Resistor Corp., Hawthorne, Calif.

Royal V. Keeran, technical director, Pomona Division of The Marquardt Corp., Pomona, Calif.

Dr. Nazzareno P. Cedrone, technical director, System Division of Bendix Aviation Corp., Ann Arbor, Mich., and **James A. Burns,** director of long-range planning.

Col. Robert F. Sladek (USAF, ret.), assistant director of engineering for administration, Page Communications Engineers, Inc., Washington, D. C., a subsidiary of Northrop Corp. Also: **Thomas E. Gootée,** assistant director of maintenance and operations for Page.

Edward A. Ritti, manager of manufacturing and service, Helicopter Division of Republic Aviation Corp., Farmingdale, N. Y. Also: **David D. Bowe,** manager of Republic's Dayton (Ohio) office.

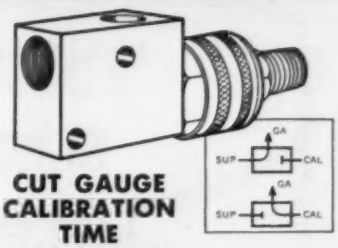
Ercole J. Vitali, manufacturing manager, Chandler Evans Corp., West Hartford, Conn.

Robert S. Ames, director of corporate planning, Goodyear Aircraft Corp., Akron, Ohio.

Jess B. Bennett, sales manager-Europe, Braniff International Airways, with offices in London, England.

Donald T. Atkinson, manager of marketing, General Electric Co.'s Missile and Space Vehicle Department, Philadelphia, Pa.

Harry W. Buckman, manager, Electronics Division of Bulova Watch Company, Inc., Woodside, N. Y., and **James D. Harlin,** sales manager.



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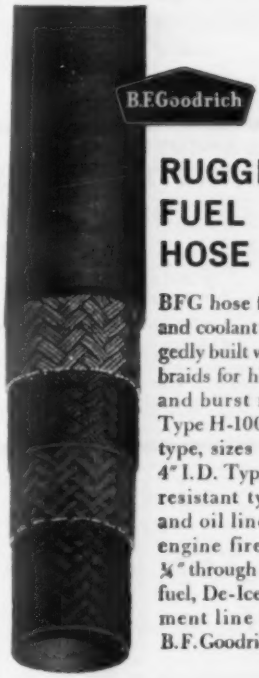

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PROBLEMATICAL RECREATIONS 5

A tennis club invites 32 players (2^5) of equal ability to compete in an elimination tournament. If both John and Jim Smith are invited, what is the chance of their playing each other during the tournament?

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LETTERS

Dedicated Leadership

In your recent report on the hearings before the House Committee on Science and Astronautics (AW Feb. 29, p. 30) you stated that I did not take a stand as to where control of the space program should be placed. This is correct as far as the Society's position is concerned. However, I should like to clarify my own position with further comments.

These comments have been supplied to the Committee as clarification for the question period during which several people tried to draw a parallel of NASA with NACA, using it as a reason for NASA's involvement in space application areas.

As noted in the testimony we must face the fact that space technology for both military and civilian agencies is a mutual problem. The comparison of NASA with NACA is not a valid one since NASA is much more involved in applications than NACA ever was. The military is perfectly capable of pursuing peaceful scientific programs in areas which may have military overtones. Antarctic exploration, for example, is a clear case in point. The Navy has had the facilities and has done much valuable work there. The same situation exists for space. The military resources for exploration are great and must be utilized. In most application areas the military is probably best suited to pursue the program under some civilian check and balance. An applications program with a military mission will get more support and much more push.

The NASA strong suit is research and early development as was done in NACA days. NASA is probably ill-suited to the applications area. It would appear that with firm leadership and a thought-out plan, NASA in research and the military in applications could advance our space efforts in concert. All we need is some clarification of charter areas and then an enforcement of this by strong dedicated leaderships, leadership which wants the United States at the top.

George R. Arthur
President
American Astronautical Society
516 Fifth Avenue
New York, N. Y.

Space Committee

My attention has been called to an editorial which appeared over your name in the Feb. 1 issue of Aviation Week and Space Technology. The editorial attacked the work of the Committee on Science and Astronautics of the House and the policies and conduct of its chairman, Congressman Overton Brooks of Louisiana.

I am a member of that Committee and have been since its inception in the first session of this Congress. As one who has faithfully attended its meetings and taken part in its deliberations, I take umbrage at the unsupported charges you make as to the quality of the Committee's work, its "contribution to public understanding of the space program . . .," and the conduct of the Committee and its respected chairman. Had you taken the trouble to read any of our 21 reports or read or attend any substantial number of our hearings I am sure you would not have been misled into editorializing on the basis of one-tenth truth and nine-tenths sheer untruth, as you appear to have done.

To carp about "bayous of technical stagnancy" in one paragraph and to turn around and criticize "technically untutored operations" and the supposed lack of a "technically qualified . . . staff" in others shows a height of inconsistency as well as a depth of ignorance as to the methods our Committee is using in educating itself in the complex fields we are exploring in order to provide the legislative guidance and policy recommendations which are our primary function. We cannot keep in the "mainstream of current space problems" without navigating the technical bayous as well. When the course is hitherto uncharted the navigator must explore all routes before settling on the most desirable. Further, and to retain your metaphor, when we are piloting a legislative ship on a course aimed at establishing broad national policy our crew must be composed not only of "technically qualified" seamen but of legislatively qualified officers as well. We suffer from no dearth of scientific information. We do suffer from a dearth of administrative responsibility in the executive agencies, as your editorial correctly indicates.

I am particularly incensed by the paragraph in your editorial which questions the ability of our Committee under its present leadership to "make any useful contributions," and charges that our efforts are a "waste (of) time of responsible government and industry leaders" while we engage in "pointless bickerings." We have made significant contributions to an understanding of this nation's problems in the fields of space and missile development and in other areas. We will continue to do so, in spite of the fact that there are occasional differences of opinion within the Committee. Without such differences there would be no need for a Committee such as ours. Helping to resolve those differences, when it is understood that our determinations may well affect America's entire future for good or ill, is hardly a waste of time for anybody. The open existence of these differences certainly belies your claim that our Chairman's tactics are dictatorial. What is a waste of time is senseless editorializing without full knowledge of the facts or full recognition of democratic procedures which must prevail in a Committee of the Congress to a greater extent than they prevail on the editorial board of a magazine.

Without question, the operations of our Committee are not perfect. May I invite you to gain a more complete insight into our problems by direct consultation with more than one source within the Committee? I am sure that Congressman Brooks and a majority of our members will be happy to cooperate with you toward that end.

Walter H. Moeller
10th District, Ohio
House Member
Committee on Science and Astronautics
Washington, D. C.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Air Safety

Regarding Clarence N. Sayen's documentation of the pilots' stand on air safety before the Senate Aviation Subcommittee (AW Jan. 25, p. 38), I have nothing but praise and high commendation for his and ALPA's vital crusade in the interest of the air traveling public. Hooray for his fearless and uncompromising stand!

I have been a dedicated reader of your fine magazine for several years, and anticipate and thoroughly enjoy each issue. Mr. Hotz's dynamic and purposeful editorials on our lagging defense effort especially should be read by all senators and representatives.

G. Hartzler
San Diego, Calif.

Decca Trials

Your article on Decca in your Feb. 22 issue (p. 43) records certain extracts from the FAA Phase I Helicopter Report, which it is assumed your reporters considered important. The heading "FAA Says Decca Fails Helicopter Trials" is, however, an assumption on the part of Aviation Week not borne out by the Airborne Instrument Laboratory's conclusions, nor by those of the FAA.

It would appear that if your reporters were alert to the situation, they would have called your readers' attention to Phase II of the Helicopter Operations Program. This program involves the use of twin-engined helicopters with instrument flight rule (IFR) capabilities and is now under way. It provides for the use of dual-Decca installations in each helicopter as the primary navigational aid during all-weather conditions.

While many of the conclusions reported in the FAA Helicopter Phase I Report are at variance with our own findings, as well as those of other users of Decca Mark VIII equipment, we, nevertheless, are studying them with interest. We look forward to an opportunity to investigate these "conclusions" in detail in cooperation with appropriate FAA personnel.

The "recommendations" contained in the FAA Phase I Helicopter Report will receive our serious consideration as soon as our investigation of the "conclusions" which led to these recommendations has been completed.

Thomas D. Johnson
Vice President
Decca Navigator System, Inc.
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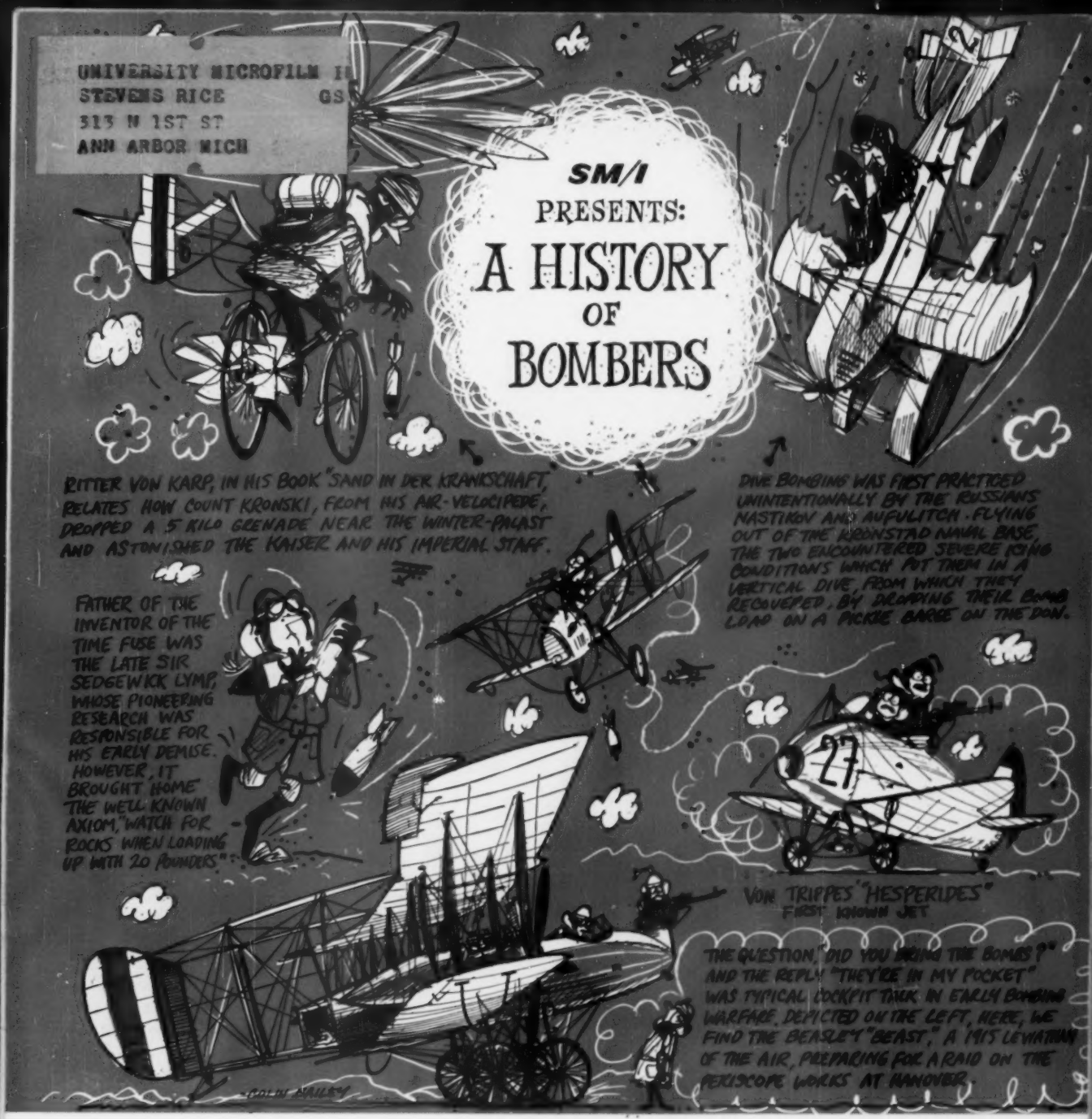
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PRESENTS:
A HISTORY
OF
BOMBERS
RITTER VON KARP, IN HIS BOOK "SAND IN DER KRANKSCHAFT" RELATES HOW COUNT KRONSKI, FROM HIS AIR-VELOCIPEDE, DROPPED A 5 KILO GRENADE NEAR THE WINTER-PALAST AND ASTONISHED THE KAISER AND HIS IMPERIAL STAFF.
DIVE BOMBING WAS FIRST PRACTICED UNINTENTIONALLY BY THE RUSSIANS NASTIKOV AND AUFULITCH. FLYING OUT OF THE KRONSTAD NAVAL BASE, THE TWO ENCOUNTERED SEVERE ICING CONDITIONS WHICH PUT THEM IN A VERTICAL DIVE, FROM WHICH THEY RECOVERED, BY DROPPING THEIR BOMB LOAD ON A PICKLE BARGE ON THE DON.
FATHER OF THE INVENTOR OF THE TIME FUSE WAS THE LATE SIR SEDGEWICK LYMP, WHOSE PIONEERING RESEARCH WAS RESPONSIBLE FOR HIS EARLY DEMISE. HOWEVER, IT BROUGHT HOME THE WELL-KNOWN AXIOM, "WATCH FOR ROCKS WHEN LOADING UP WITH 20 POUNDERS."
VON TRIPPES "HESPERIDES" FIRST KNOWN JET
THE QUESTION, "DID YOU BRING THE BOMBS?" AND THE REPLY "THEY'RE IN MY POCKET" WAS TYPICAL COCKPIT TALK IN EARLY BOMBING WARFARE, DEPICTED ON THE LEFT. HERE, WE FIND THE BEASLEY "BEAST," A 1915 LEVIATHAN OF THE AIR, PREPARING FOR A RAID ON THE PERISCOPE WORKS AT HANOVER.
COLIN BAILEY

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